

THE LINNEAN SOCIETY OF LONDON.

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1927-28.

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PROCEEDINGS
OF
THE LINNEAN SOCIETY OF LONDON.



140TH SESSION.

FROM NOVEMBER 1927 TO MAY 1928.

LONDON:

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1928,

THE LINNEAN SOCIETY OF LONDON.

PATRON.

HIS MOST EXCELLENT MAJESTY THE KING,
EMPEROR OF INDIA.

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HIS MAJESTY GUSTAV V., KING OF SWEDEN.

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PUBLICATIONS: FROM JUNE 1927-MAY 1928.

Journal, Botany.

Vol. XLVII.	No. 317.	8/-
	„ 318.	10/-
	„ 319.	8/-

Journal, Zoology.

Vol. XXXVI.	No. 246.	6/-
	„ 247.	8/-

Proceedings, 139th Session, December 1927. 8/-

List of Fellows, Associates, and Foreign Members, Nov. 1927.

PROCEEDINGS
OF
THE LINNEAN SOCIETY OF LONDON.

(ONE HUNDRED AND FORTIETH SESSION,
1927-1928.)

3RD NOVEMBER, 1927.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous General Meeting (Anniversary), held on Tuesday the 24th May, 1927, having been circulated, were taken as read and confirmed.

The PRESIDENT announced that he had appointed the following Fellows as Vice-Presidents for the Session 1927-28: Dr. A. B. Rendle, F.R.S., Mr. H. W. Monckton, V.-P.G.S., Mr. A. D. Cotton, and Dr. R. W. T. Gunther.

The PRESIDENT announced the death of Dr. Benjamin Daydon Jackson on the 12th October, 1927, following upon a street accident on the 1st October, and moved the following Resolution, which was passed in silence, all standing:—

That the Fellows and Associates of The Linnean Society of London in General Meeting assembled desire to express their sorrow on hearing of the death of Dr. B. DAYDON JACKSON, who had been a Member of the Council from 1880 to 1902, General Secretary from 1902 to 1926, Vice-President 1926-27, and Curator of the Linnean Collections from 1926. During his long period of office Dr. Jackson had given the most competent and devoted service to the Society and he had lost no opportunity of advancing its interests in every possible way.

The Assistant-Secretary was directed to send a copy of the Resolution to Mrs. Jackson.

A statement of the donations received since the 24th May, 1927, was laid on the table.

The following were admitted Fellows:—James Edgar Dandy and George Matthai.

The PRESIDENT announced that in consequence of the death of George Charles Champion on the 8th August, 1927, there was a vacancy in the List of Associates.

Certificates of recommendation for election to Fellowship were read as follows:—For the second time in favour of Miss Mary Dilys Glynne and Raymond Henry Stoughton. For the first time in favour of David R. R. Burt, Harold Kendall Hewison, Roger William Butcher, William Alfred Pritchard Jones, Richard William George Hingston, Miss Marion Moss, Eustace Cecil Barton-Wright, Walter Robert Ivimey Cook, Miss Margaret Joan Latter, Miss Francis Marion Lina Sheffield, Arthur Hugh Garfit Alston, Frederick Robert Irvine, Hugh Scott, Frank Young Henderson, Yājñavalkya Bhāradwāja, Allan Uggle, Julian Sorrell Huxley, and Amin Fikry.

A certificate of recommendation for election to Associateship was read for the first time in favour of William Crosfield Worsdell.

The following candidates were balloted for and elected as Fellows:—Miss Eugenie Sachs, Percy George Netley, Henry James Howard, and Lewis Guy Peirson.

Dr. R. W. T. GUNTHER exhibited a collection of rotographs of unpublished letters of John Ray, the exhibition being supplemented by a volume—kindly lent by the Royal Society—containing some original letters.

The former were written by Ray to the antiquary, John Aubrey, and to the Keeper of the Ashmolean Museum, Edvard Lhwyd, between 1676 and 1703. They therefore cover an important part of Ray's life, and are supplemental to the letters edited for the Ray Society by Dr. Edwin Lankester in 1848, when they do not appear to have been available for study.

It is now proposed to print them *in extenso* as an extra volume in the Ray Society's Series, together with Ray's letters to the Secretaries of the Royal Society, and with those portions of his other letters which his editor of 1848 saw fit to omit.

Dr. Gunther will be very glad to receive information as to the whereabouts of any other unpublished letters by the distinguished naturalist.

Dr. Gunther, in reply to a question by Mr. A. W. Sheppard, stated that Willughby was chiefly responsible for the description of the fishes in Ray's works. Dr. A. B. Rendle referred to the possibility of discovering some Ray MSS. still missing.

Mr. T. A. SPRAGUE gave an account, illustrated with lantern-slides, of Brunfels as a botanist, together with a brief sketch of his life. A study had been made of all the plants illustrated in his Herbal. His interest in plants seems to have been chiefly confined to their medicinal properties, on which his classification was largely based, with the result that some of his "genera" were highly artificial. "*Scrophularia*," for example, included the species now known as *Scrophularia nodosa*, *Sedum Telephium* and *Ranunculus Ficaria*, belonging to three different natural families.

His use of the terms "male" and "female" sometimes indicated differences in flower-colour between two plants which were otherwise more or less similar, the deeper colour in the following order—red, blue, yellow, white—being "male," and the paler colour "female": thus the yellow water-lily was *Nenufar mas*, and the white one *Nenufar foemina*. The term "female" in other cases indicated a spurious kind or an abnormality.

It is frequently difficult to correlate the illustrations with the names given in the text, which often consists almost exclusively of extracts from classical or mediaeval authors. A certain amount of additional information, such as particulars of flower-colour, is sometimes given in the German edition, and this is often helpful in determining the species. The Herbal derives its importance from the fact that it contains the first recognisable illustrations of many of the Linnean species, of which indeed they may often be regarded as the historic types.

Dr. Rendle expressed his interest in Mr. Sprague's study, and emphasised the historical importance of many of the illustrations in Brunfels's works. A question by the President as to the origin of the name and the use of *Chenopodium Bonus-Henricus*, one of the plants figured by Brunfels, elicited testimony from Miss G. Lister, Mr. T. A. Dymes, and Mr. J. W. Bodger as to its use as a salad in various parts of England, while Mr. J. C. Shenstone suggested the possibility of this species being an escape from herb-gardens.

Mr. S. K. MUKERJI gave an account, illustrated with lantern-slides, of his investigations of the Biological Relations of *Mercurialis perennis* L., of which the following is an abstract.

A detailed study has been made of plants from various parts of England, together with experimental cultures, and herbarium specimens. A new variety of *M. perennis* was found in Kent. The Far-Eastern *M. leiocarpa* Sieb. & Zucc., is a variety of *M. perennis*. Specimens from China previously regarded as *M. leiocarpa* are identical with *M. perennis*. Some of the so-called varieties of *M. perennis* are merely habitat forms. The specific distinction between *M. corsica* and *M. elliptica* and between *M. ovata* and *M. perennis* is doubtful.

The geographical distribution of all the species of the genus has been worked out. The known range of *M. perennis* has been considerably extended, and the discontinuity in distribution of the genus is more apparent than real.

Seed output is low in *M. perennis* compared with many other woodland species, and only about 10 per cent. of the seeds formed in England are germinable. The root-system shows branched and unbranched roots, both infected with fungi, particularly the former. Depth of penetration depends on the soil-type, water content, soil-reaction, and other edaphic factors. Shallow rooting is associated with very high water content, and the lower the acidity the deeper the penetration. The average "working depth" is 12-15 cm. and the maximal 28-30 cm. The average osmotic pressure of the expressed root-sap in the spring is 0.48097 atmospheres. Stem-height ranges from 8 cm. to 65 cm., and great variation in leaf form and size occur. The leaf margin bears hydathodes secreting an acid liquid containing KCl and $\text{Ca}(\text{CO}_3)_2$. The expressed leaf-sap shows a marked pH-gradient, the lower leaves giving values pH 5.8-6.0 and the uppermost ones pH 4.8-5.0.

An intergradation of sex has been observed, and the sporadic occurrence of male or hermaphrodite flowers on female plants been recorded. Pollination is partly entomophilous but mainly anemophilous. The fruit explosively ejects the seeds to a distance of about 4 metres. Periodicity is well marked and varies with altitude and latitude, but continuous growth can be induced under experimental conditions.

M. perennis occurs in soils with water content ranging from 10 to 80 per cent., the optimum growth being attained between 40 and 55 per cent. The echard and hollard of loamy soil from Orpington were 12 per cent. and 47 per cent. respectively, while in peat the values were 18 and 72 per cent. The range of soil reaction was from pH 4.5 to pH 8.2, optimum development occurring about the neutral point. A negative correlation obtains between dry weight and the ratio of specific acidity and water content. High-water content ameliorates the effect of acidity.

M. perennis shows no correlation between dry weight and the total carbonate content of the soil, and it is apparently not a true calcicole but an oxyphobe. It shows decided preference for soils with a high organic content. The nitrate content of the soil does not markedly influence growth, but low nitrate content retards or may even suppress flowering. Light intensity distinctly affects the distribution and growth of individuals of the different sexes separately, and it is suggested that light intensity may determine the sex of a plant under certain conditions. The species shows distinct secondary morphological and physiological sexual characters. The photosynthetic mechanism of female plants functions best in lower light intensity, that of the males in much higher.

Owing to the lateness of the hour there was little time for discussion, but Dr. E. J. Salisbury paid a tribute to the great value of such auto-ecological work as Mr. Mukerji had undertaken. Mr. A. R. S. Proctor stated that *M. perennis* was particularly abundant on the slopes of the Limestone Dales of Derbyshire,

where it forms an unbroken carpet up to 700 feet, under a canopy of spontaneous Ash. He had often noticed that under such conditions the great majority of the plants were male, whereas this preponderance was not so pronounced under the greater shade of Oaks or Beech. With reference to the two flowering periods, he had found at Matlock on the 2nd November, 1927, at 600 feet, several male plants in flower. Possibly the abnormal summer may have had some influence in bringing this about.

17TH NOVEMBER, 1927.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 3rd November, 1927, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table. The President drew particular attention to and invited imitation of the generosity of Mr. H. N. Dixon, who, although a Compounder, had given a banker's order to pay to the Society £1 on the 24th May annually.

Certificates of recommendation of the following candidates for Fellowship were read for the second time:—David R. R. Burt, Harold Kendall Hewison, Roger William Butcher, William Albert Pritchard Jones, Richard William George Hingston, Miss Marion Moss, Eustace Cecil Barton-Wright, Walter Robert Ivimey Cook, Miss Margaret Joan Latter, Miss Francis Marion Lina Sheffield, Arthur Hugh Garfit Alston, Frederick Robert Irvine, Hugh Scott, Frank Young Henderson, Yājñavalkya Bhāradwāja, Allan Uggla, Julian Soreil Huxley, and Amin Fikry.

Certificate of recommendation of the following candidate for Associateship was read for the second time:—Wilson Crosfield Worsdell.

The following candidates were balloted for and elected as Fellows:—Miss Mary Dilys Glynne, M.Sc., and Raymond Henry Stoughton, B.Sc., A.R.C.S.

Mr. N. E. Brown, A.L.S., read the following introduction to his paper on "The South African Species of Iridaceæ in Thunberg's Herbarium," the paper itself being too technical for reading:—

"Carl Pehr Thunberg was born in 1743, and in due course became a pupil of Linné, and afterwards Professor of Botany at Upsala. He made voyages to South Africa, Java, and Japan, and

after his return published an account of his travels and described the plants he had collected. He sailed from Europe on Dec. 30, 1771, and landed at Cape Town on April 17th, 1772, the journey occupying fifteen weeks, in contrast with the three weeks it now takes to accomplish.

"Thunberg stayed in South Africa nearly three years, and sailed to Java on March 2nd, 1775. During his stay in South Africa he made three extensive journeys into various parts of it, and in two of them was accompanied by Francis Masson, who was sent to collect living plants for the Royal Botanic Gardens at Kew, and who first introduced many of the South African plants that now adorn our gardens and greenhouses.

"Thunberg sent or brought back from the Cape a large collection of dried plants which he had discovered, and described them in numerous separate pamphlets and in his '*Prodromus Plantarum Capensium*' and '*Flora Capensis*.' Many were described also by the younger Linné.

"This fine collection consists of well-dried specimens, now preserved in the Botanic Garden at Uppsala, and I am indebted to Prof. Juel and his predecessors for the privilege of being able to examine various portions of it. The collection forms the basis of our knowledge of South African plants, and it is necessary to consult it when accurate determinations of any South African group of plants have to be made. Having been asked to work out the Iridaceæ for Dr. Burt Davy's '*Flora of the Transvaal*,' I considered it necessary to examine Thunberg's types of the species he had described, some of which are stated by Mr. Baker in the '*Flora Capensis*' to grow in the Transvaal. As Thunberg was never nearer than about 400 miles from that region—for he travelled only eastwards through the coastal and subcoastal Divisions, and north and north-westward as far as the Doorn River and the Roggeveld in Calvinia Division,—and as the Transvaal has quite a different flora from that of the parts where Thunberg travelled, I much doubted the correctness of some of the determinations.

"My examination of Thunberg's types justified my suspicion, and the result of that examination is recorded in the account of them now offered to the Linnean Society. As the account is of a technical nature, I will only mention that in it I have redescribed some of the species, and have restored and re-characterised the genera *Dietes* and *Heliopsis* proposed by Salisbury, which have not hitherto been acknowledged, although clearly distinct from *Morea* and *Iris*, under which they have been placed. I would also draw attention to the fact that, although most of the ground over which Thunberg collected has been traversed by several (and in some parts by many) collectors, there are many species in Thunberg's herbarium that appear not to have been rediscovered during the 152 years that have elapsed since he collected them.

As an instance of the rarity of some South African plants, I may mention that Dr. John Muir, of Riversdale, informs me

that he discovered a species of *Mesembryanthemum* at a locality within sight of his house, but has never been able to find it again. Many years ago a collector informed me that when he visited Dr. Atherstone (at that time a resident at Grahamstown), the doctor told him that in the previous year (about 1860) not far from his house he saw a bulb in flower in abundance which he had never seen previously during the many years he had lived there, and although he took the collector to the spot where it grew, they failed to find it.

Dr. A. B. Rendle, F.R.S., referred to the great value to systematic botanists of Mr. Brown's paper, and suggested that the account read by Mr. Brown to the meeting should be published as a preface to his paper.

Mr. A. W. EXELL, M.A., exhibited some hybrids of *Cotoneaster frigida* Wall. which had arisen in the Bagshot nurseries of Messrs. Waterer, Sons & Crisp, and gave an account of their probable parentage.

Mr. G. W. E. Loder expressed the opinion that views as to the production of new forms by hybridisation were apt to be rather speculative. *Cotoneaster*, of which there were about forty recognized species in cultivation, like *Berberis*, showed a great tendency to "sport," and very strict tests were necessary to make sure that the new forms were not the result of changes in the conditions of cultivation.

Mr. J. Ramsbottom laid stress on the absence of exact evidence as to what takes place when plants are cultivated in a garden free from the competition natural to them in a wild state. He instanced as having a bearing on the problem the case of such fungi as *Fusarium*, which when grown in pure culture would start to "sector," such sectors when cultivated separately either remaining pure or reverting after some time to the original habit or further differentiating.

The President raised the question whether the hybrids were really of the F_1 generation and suggested the possibility of the supposed pure *C. frigida* being itself an F_1 with the *C. frigida* strain dominant.

Mr. Exell, in reply, admitted the necessity for the care in investigation advised by Mr. Loder, but in the particular instance was of opinion that the character of the leaves left little doubt that hybridisation had occurred. He did not gainsay the possibility of the male parent being an F_1 generation, but the female parent, from which all the seeds were taken, undoubtedly was pure.

Prof. GEORGE MATTHAI, M.A., exhibited photographs, drawings, and lantern-slides of recent Meandroid *Astræid* Corals, and gave an account of his investigations into the group.

The exhibition represented nearly all the known species and illustrated material collected from the Indo-Pacific (including the

Red Sea) and the Atlantic regions as well as type-specimens in the European and American museums. The photographs were taken with a view to show the probable limits of genera and species, the range of skeletal variation within each species, the appearance of the soft parts and of stages in the growth of colonies, and illustrated for the first time many of the types of previous authors.

The drawings showed the histology of polyps after decalcification, and were made from serial sections.

The plates will accompany a forthcoming monograph in which a revised classification of the group is made from a comparative study of their hard and soft parts and of existing type-specimens.

Dr. W. T. Calman, F.R.S., referred to the great difficulty in the systematic study of the group, and both he and Dr. Bidder expressed high appreciation of Prof. Matthai's work.

1ST DECEMBER, 1927.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 17th November, 1927, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

Miss Mary Dilys Glynne, M.Sc., was admitted a Fellow.

The following candidates were balloted for and elected as Fellows:—

DAVID R. R. BURT, B.Sc., Ceylon University College, Colombo.

HAROLD KENDALL HEWISON, Superintendent of Agriculture, Gold Coast Colony.

ROGER WILLIAM BUTCHER, B.Sc., 32 Hinton Avenue, Cambridge.

WILLIAM ALFRED PRITCHARD JONES, B.Sc., M.Sc., Senior Biology Master, Llandrindod Wells County Secondary School, Radnor.

RICHARD WILLIAM GEORGE HINGSTON, M.B., C.M., Major, Indian Medical Service.

Miss MARION MOSS, B.Sc., 21A Muswell Avenue, London, N.10.

EUSTACE CECIL BARTON-WRIGHT, B.Sc. (Lond.), Lecturer in Botany, King's College, University of London.

- WALTER ROBERT IVIMEY COOK, B.Sc., Ph.D., King's College, University of London.
- Miss MARGARET JOAN LATTEB, Ph.D. (Lond.), Demonstrator in Botany, King's College, University of London.
- Miss FRANCES MARION LINA SHEFFIELD, M.Sc. (Lond.), Research Assistant in Botany, King's College, University of London.
- ARTHUR HUGH GARFIT ALSTON, B.A., Systematic Botanist, Dept. of Agriculture, Ceylon.
- FREDERICK ROBERT IRVINE, M.Sc. (Durham), Professor of Biology, Achinota College, Gold Coast Colony.
- HUGH SCOTT, M.A., Sc.D., F.E.S., Curator in Entomology, University Museum of Zoology, Cambridge.
- FRANK YOUNG HENDERSON, D.Sc., D.I.C., 83 Holmleigh Road, Stamford Hill, London, N.16.
- Pandit YÂJÑAVALKYA BHÂRADWÂJA, M.Sc., Assistant Professor of Botany, Benares Hindu University, India.
- ALLAN UGGLA, Lt.-Col., Military Attaché to the Royal Swedish Legation, 27 Portland Place, London, W.1.
- JULIAN SORELL HUXLEY, M.A., King's College, University of London, Fullerian Professor of Physiology in the Royal Institution of Great Britain.
- AMIN FIKEY, Research Student, School of Agriculture, Egypt.

The following candidate was elected an Associate:—

WILSON CROSFIELD WORSDELL, Hon. Mem. R.H.S.,
45 The Avenue, Kew Gardens, Surrey.

A specimen of luminous wood, sent by Mr. J. E. HOSKING, F.L.S., was exhibited. The specimen had been taken from a tree that had been lying for some time on leaf-mould in a wood at Ham Street. Mr. Hosking had noted that many other parts of the same tree were equally luminous.

Mr. J. Ramsbottom explained the luminosity as due to the invasion of the timber by the fungus *Armillaria mellea*, and, in reply to questions by the President and Mr. R. H. Burne, stated that luminosity in fungi was caused by the same reactions of luciferin and luciferase as occurred in animals; the luminosity was continuous if the temperature was above freezing-point and in the presence of oxygen.

Mr. Miller Christy referred to barn-owls sometimes appearing luminous on account of particles of luminous wood from the lining of their nest-holes adhering to their plumage.

Mr. J. W. BODGER, F.L.S., exhibited specimens of fasciation in the Ash and Horse Chestnut, which he had collected near Elton in Huntingdonshire. Lt.-Col. J. H. Tull Walsh, Mr. I. H. Burkill, and Mr. W. C. Worsdell commented on the exhibit.

Miss D. AUBERTIN, M.Sc. (Visitor), opened a discussion on the question, "Are the Mollusca a Monophyletic Group?" and illustrated her remarks with lantern-slides. She supported the theory of Von Jhering that the Mollusca are not a homogeneous group, but are probably derived from two distinct phyla of lower invertebrates. Von Jhering's work on the morphology of the nervous system of the Mollusca and the views of Thiele, Odhner, and others on the systematic position of the Solenogastres were explained.

Mr. G. C. ROBSON, M.A. (Visitor), supported the orthodox view that the Mollusca are a homogeneous, monophyletic group, and that the chief structural resemblances between the members of the different classes of the phylum can be more satisfactorily explained by reference to a common ancestry than by assuming that they are due to convergence.

The President referred to Pelseneer's results, based on his study of the anatomy of *Actæon*, *Scaphander*, and other Ophisthobranchs, as showing the existence of very great difficulties in accepting the conclusion that the Euthyneura are not nearly related to the Streptoneura. He agreed with Mr. Robson's opinion that a monophyletic origin of the Mollusca is indicated by the assemblage of morphological characters commonly regarded as characteristic of these animals.

Mr. A. T. HOPWOOD, F.L.S., exhibited and gave a description—illustrated with lantern-slides—of vertebrate remains from the Miocene of Kenya Colony.

The specimens were of especial interest as being the first mammals from beds older than the very top of the Pliocene to be recorded from the Eastern half of Central Africa. The collection contained three genera of Creodonts, two of Artiodactyls, and three or four of Rodents containing some seven or eight species. The Rodents are closely allied to those living in the region at the present day.

The only other fauna of similar date known from Africa south of the Equator is that described by Stromer in 1926 from the hinterland of Elizabethsbucht. He describes Creodonts, Rodents, of which one or two genera are also found in Kenya Colony, Hyracoids, Artiodactyls, Suoids, and a Rhinocerotid.

Time did not permit of any discussion of Mr. Hopwood's paper, but in a reply to a question by Mr. H. W. Monckton, it was stated by Mr. Hopwood that the remains were undoubtedly contemporaneous with the deposit in which they were found.

Major S. S. Flower referred to the discovery of elephant fragments in the deposits excavated at the site of the Blue Nile bridge.

15TH DECEMBER, 1927.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 1st December, 1927, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

The PRESIDENT read a paragraph from 'Nature,' of the 10th December, 1927, commemorating the first election of women as Fellows of The Linnean Society of London on the 15th December, 1904.

The following were admitted Fellows:—James Lawrence Chaworth-Musters, Roger William Butcher, Major Richard William George Hingston, Roger Crompton Notcutt, Walter Robert Ivimey Cook, Raymond Henry Stoughton.

The PRESIDENT read the following letter from the Hon. Gerald H. C. Chichester, Assistant Private Secretary to Her Majesty the Queen, all present standing in their places:—

BUCKINGHAM PALACE.

21st November, 1927.

Dear Sir SIDNEY HARMER,—

I have had the honour to submit to the Queen your letter to Sir Harry Verney of November 18th.

In reply I am commanded to convey to you, and to the Council of the Linnean Society of London, the Queen's sincere thanks for the kind suggestion put forward in your letter, that Her Majesty should consent to become an Honorary Member of the Society, and I am to say that the Queen is graciously pleased to accede to this proposal.

Thanking you for your courteous letter,

Believe me,

Yours very truly,

GERALD CHICHESTER,

Assistant Private Secretary to the Queen.

Sir SIDNEY F. HARMER, K.B.E.,

President,

The Linnean Society of London.

The intimation that Her Majesty had graciously consented to become an Honorary Member was received with acclamation.

Certificates of recommendation in favour of the following candidates were read for the first time:—Cecil Stevenson Garnett, Assoc.Met. (Sheffield University), F.C.S., F.G.S., Derby; William Kirk Bryce, Baptist Minister, The Manse, Beaconsfield Road, St. Albans, Herts.

Dr. K. MÜNSTER STRÖM (Visitor from Oslo) read his paper, illustrated with lantern-slides, on "Recent Advances in Limnology." See page 96 for the full paper, of which the following is an abstract:—

The subject of limnology as a synthetic science is to investigate the reciprocal action of biotopes and biocenoses, and the cycle of organic substances within the microcosms represented primarily by the lakes. For the solution of those great general questions in biology, fresh waters possess quite special advantages, not shared by any other biotopes.

When the different lakes are thus regarded as units, the question of establishing natural lake types is raised. In the last few years a large number of extensive and important researches have been made, which all confirm that the three biological lake types, *eutroph*, *oligotroph*, and *dystroph*, recognised by Naumann and Thienemann, must be regarded as natural, and should form the base for attempts to establish more detailed classification schemes.

The principal topic of the address was the discussion of the researches mentioned, which have yielded a large material of facts with regard to the circulation of substances, oxygen stratification, bottom fauna and deposits. The relative importance of those investigations in permitting conclusions towards the establishment of a detailed natural classification was discussed. A scheme embracing all lake types known at present was put forward, based upon the (N+P), Ca, and Humus "spectra" proposed by Naumann for expressing the position of an individual lake with regard to those essential factors.

In the discussion following the paper, the President referred to the sparse opportunities in Great Britain—apart from the Scottish Lochs and English Lakes—for limnological investigations. Dr. G. P. Bidder asked if it were not the case that photosynthesis ceased at much less depths in lakes than in the sea. Dr. Ström admitted this, and stated that although in exceptionally clear lakes organisms were found down to a depth of 50 m., in the ordinary rather turbid lakes photosynthesis ceased at much less depths.

Prof. F. E. Fritch drew attention to the classification of the lakes of the English Lake District adopted by the Pearsalls. They found that lakes with a rocky bottom had a Desmid-plankton, while those which were appreciably silted had a plankton composed mainly of Blue-green Algæ and Diatoms. They had produced evidence that the silted lakes represented

a further stage in the evolution of the rocky lakes, and that some were not so far advanced as others in this respect. It seemed that this was a good example of progression from the *oligotrophic* to the *eutrophic* type.

Mr. D. J. Scourfield expressed his appreciation of Dr. Ström's paper, and particularly of his remarks regarding the possibilities for further limnological work in the British Isles, and called attention to the fact that a very good start had been made by the Bathymetrical Survey of the Scottish Lochs—with which he had been associated,—not to mention less extensive investigations carried out on the lakes of other parts of the British Isles. Even the Scottish Lochs Survey was by no means exhaustive, as it was primarily a bathymetrical survey with the biological work more or less incidental. A large amount of limnological work remained to be done in Scotland, Ireland, the English Lake District, and North Wales. The need of several properly equipped limnological stations was evident. A lake was a unit, the investigation of which—owing to the comparative simplicity of the conditions—should throw light on many biological and physical problems. Even if the small station on the Norfolk Broads were reopened, it would not do away with the necessity for a station on a fairly large and deep lake, as the conditions of the Norfolk Broads were peculiar and differed from those of proper lakes.

Dr. T. A. STEPHENSON (Visitor) read his paper, illustrated with lantern-slides, on "Species among the Coelenterata," of which the following is an abstract:—

Coelenterate species are difficult to define. The general morphology of the group is now well known, and with it a considerable amount (though too little) of histology. Sometimes it is not easy, even when the whole morphology of a species is taken into account, to distinguish it from an allied form. The characteristics of the nematocysts have been suggested as useful criteria for specific distinction. These structures are characteristic of Coelenterata; their variations appear to be arbitrary, and might therefore be expected to prove helpful. A recent investigation of the nematocysts of Actiniaria has been made, with abundant fresh material, to find out how far the characteristics of these capsules form trustworthy criteria. The British Actiniaria possess this advantage, that a study of their habits has revealed quite clearly the actual limits of the various species, which are sharply marked off from one another by their methods of reproduction. The results show that the structure of nematocysts is a useful generic and family character, and that their size sometimes distinguishes species; but that in critical cases they give no assistance, and that differences of habits are here the decisive factors.

In the short time left for discussion of the paper, Dr. G. P. Bidder referred to the difficulties experienced in the specific

identification of sponges on morphological grounds alone as similar to those encountered by Dr. Stephenson in the British Actinaria. He attributed these difficulties to the mixture of strains, and suggested that variations in nematocysts might be caused by changes in the environment.

Dr. W. T. Calman paid tribute to the excellence of Dr. Stephenson's work, but was not inclined to accept his criteria of specific distinction as invariably valid.

The President referred to the great difficulties in the classification of corals and the importance of such work as Dr. Stephenson's in helping to clear them up.

5TH JANUARY, 1928.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 15th December, 1927, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

The following were admitted Fellows:—Lewis Guy Peirson, Wilfrid Robinson, Henry James Howard, Frederick Augustus Secrett.

The PRESIDENT read a letter from Sir Harry L. Verney, K.C.V.O., Private Secretary to the Queen, conveying Her Majesty's gracious acknowledgment to the Society for Her Honorary Membership.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time in favour of William Kirk Bryce and Cecil Stevenson Garnett. For the first time in favour of Miss Mary Margaret Chattaway, M.A., B.Sc.

Dr. D. H. SCOTT, F.R.S., communicated an account, illustrated with lantern-slides, of a paper by Dr. Suzanne Leclercq and M. Bélliére on *Psymphyllum Gilkineti*, sp. nov., from the Middle Devonian (with Old Red Sandstone facies) of Malonne, Belgium. The following is an abstract of the paper:—

An arborescent or at least suffrutescent plant. Axis woody, smooth, ramified, furnished with numerous distant, non-sheathing leaves, spirally arranged. Leaves large, coriaceous, and with long petioles. Limb flabelliform, 10-14 cm. in length and 10-15 cm. in width; wider at the apex than at the base, where it suddenly narrows; lateral margins regular; apex rounded, entire or with wide but not deep lobes. Nervation not well marked; nerves

parallel, radiating from the base to the apex of the limb with frequent (?) dichotomies. Limb prolonged by a pseudo-petiole, 20-33 cm. long, tapering from the base of the limb to its point of insertion on the axis. Angle of insertion varying according to the position of the leaf on the axis. Nerves parallel, fine, continuing those of the limb.

Stratigraphic position: Middle Devonian of Old Red Sandstone facies (Couvinian) of Malonne, Province of Namur, Belgium.

Species named in honour of the late Professor Alfred Gilkinet.

The whole extent of the principal specimen is about 1 ft. 10 inches in height by 3 ft. 2 inches in width, with leaves reaching to 18 inches in length, including the long and rigid petiole. The authors point out the importance of the discovery:—1. As a new species of a little-known genus. 2. As a plant with a strong, woody, and branched stem. 3. As derived from so old an horizon—the base of the Middle Devonian.

Prof. F. E. Weiss recalled the work of the late Dr. E. A. N. Arber on the group of plants to which *Psymphyllum* was related, and was inclined to accept the suggestion of the authors of the paper that *P. Gilkineti* was amongst the forerunners of the Gymnosperms.

Mr. H. W. Monckton remarked that the paper was of particular interest in that it recorded the occurrence of land plants in the Couvinian of Belgium, which was largely a formation of shale and limestone with marine fossils and masses of coral, which Belgian geologists looked on as coral reefs. He drew attention to the occurrence of land plants in the Devonian of much the same age in Britain and the Boulonnais.

Prof. S. H. WILLIAMS, of the University of Pittsburg (Visitor), gave a most interesting account, illustrated with a large series of beautifully-coloured lantern-slides, of his experiences in the jungles of British Guiana while he was in charge of the University of Pittsburg Investigations in that country.

The Tropical Research Station, which was acquired from the New York Zoological Society, is situated at the junction of the Mazaruni and Cuyuni rivers, in the heart of the largest and least-known jungle area in the world. In addition to spending some time at the permanent station, Professor Williams travelled into the highlands in the interior, beyond Kaieteur Falls, in order to make a study of zonal distribution of Coleopterous insects. He discussed, generally, the Natural History of the country, and showed over one hundred lantern-slides of the rivers, jungle, unusual water forms, jungle animals, and natives.

Mr. T. B. Blow gave reminiscences of his own travels in practically the same region in 1894, when he was collecting Characeæ.

Mr. H. N. Ridley remarked on the general similarity of the British Guiana jungles to those of the Malay Peninsula, and

commented on the absence of elephants and tigers and the fact that the lecturer had made no mention of leeches in his list of the amenities of life in British Guiana.

The President expressed the feeling of the meeting in warmly complimenting Prof. Williams on the beauty and interest of his slides. He referred to the dolphin (*Sotalia guianensis*), that appeared in two of the slides, as of particular interest to him in being one of the few species found in rivers. One species of the genus occurred in China, and another, which was herbivorous, in West Africa. He enquired whether the British Guiana species was herbivorous or carnivorous. He recalled that d'Orbigny had described the same difficulties in capturing these animals that Prof. Williams had experienced.

In reply, Prof. Williams stated that the Guiana dolphin was a fish-eater.

19TH JANUARY, 1928.

SIR SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 5th January, 1928, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

The following were admitted Fellows:—Miss Marion Beatrice Moss, B.Sc.(Lond.); Lt.-Col. Allan Uggle.

A certificate of recommendation for Fellowship was read for the second time in favour of Miss Mary Margaret Chattaway, M.A., B.Sc.

The following were balloted for and elected Fellows:—William Kirk Bryce: Cecil Stevenson Garnett, Assoc.Met.(Sheffield University), F.C.S., F.G.S.

Mr. C. V. B. MARQUAND gave an account, illustrated with lantern-slides, of the collection of plants made by Capt. F. Kingdon Ward in the Eastern Himalaya and Tibet in 1924-25.

Capt. F. Kingdon Ward accompanied the last Mount Everest Expedition when it started out from Darjeeling, then travelling in an easterly direction from Gyantse to Tsetang over unexplored ground, and crossing the Temo La to Tumbatse, he entered the region in the neighbourhood of lat. 29° 40' N., long. 95° E., where the most important part of the collection was made. A short distance east of Tumbatse several high passes over the

eastern extremity of the Himalaya were traversed. On the highest of these passes, the Nam La, over a southern spur of the lofty Namcha Barwa at an altitude of 17,500 ft., many alpine were collected. In the month of August, 1924, an extensive collection was made around the Trasum Lake, and the Banda La—a pass of over 18,000 ft., the most northerly point of the Expedition—was visited. On the return journey through Bhutan several species were found which had not been collected since they were discovered by Griffith nearly a century ago.

An account of the Sino-Himalayan Flora was communicated by Capt. Kingdon Ward to the Society last May and appeared in *Proc. Linn. Soc.* 1926-27, pp. 67-74.

Excluding the three genera *Meconopsis*, *Rhododendron*, and *Primula*, which are dealt with elsewhere, the collection comprises 446 species, including 54 new species as well as 26 new varieties.

The genera most strongly represented, apart from the three mentioned above, are *Saxifraga*, 26 spp., nine being new; *Gentiana*, 16 spp., one new; and *Pedicularis*, 20 spp., three new. Four new species of *Lychnis*, three of *Corydalis*, two each of *Delphinium*, *Impatiens*, and *Buddleia*, and one each of 28 other genera are described as new.

Mr. I. H. Burkill agreed with the remarks made by Mr. Marquand in the course of reading his paper as to the important influence of the Monsoon on the distribution of species. He had found in the Abor Hills that the Indian element in the flora tailed off with the diminishing Monsoon.

Major R. W. G. Hingston stated that in the Mount Everest Expedition he had found spiders at an altitude of 22,000 feet, and asked for information regarding the altitudinal limits of plants in the region traversed by Captain Kingdon Ward.

Mr. H. N. Dixon, with reference to the new genus which Mr. Marquand had stated he intended to establish, pointed out that the name was preoccupied by a genus of Mosses.

With regard to the paucity of Cryptogams in the collection, Mr. J. Ramsbottom remarked that probably a fair number of micro-fungi had been incidentally collected, and he suggested that a close examination of the collection might yield valuable results.

Mr. R. Paulson stated that he had found on the Rhododendrons in Captain Ward's collection over thirty species of Lichens, and the examination would probably throw light on their distribution.

Mr. G. Tandy, with reference to Major Hingston's remarks, suggested that where animal life had been found plant life was bound to be also.

Mr. Marquand, in reply, stated that Capt. Kingdon Ward did not gather anything above 18,000 feet. It was surprising that Mosses and Lichens should not have been found far above the highest flowering plants in the Himalaya. In the Alps *Ranunculus glacialis* reaches the greatest altitude for Phanerogams on the shoulder of the Matterhorn; Bryophytes occur at a still

greater altitude; while he had collected several species of saxicolous Lichens on the summit rocks of Monte Rosa (15,200 ft.). Allowing for the difference of latitude between the European Alps and the Himalaya, where the snow-line is some 9000 feet higher, Lichens would be expected on Mount Everest to at least 24,000 ft. and possibly much higher, and Mosses should be found to nearly this altitude. This might explain the presence of spiders and insects so high on Mount Everest.

Mr. F. W. EDWARDS, M. A. (Visitor), gave an account, illustrated with an extensive series of lantern-slides, of his expedition to investigate the blood-sucking flies of the Southern Andes. The slides pictured the varying aspects of physiography and vegetation of the route traversed.

The Expedition was a joint one arranged by the British Museum (Natural History) and the Bacteriological Institute of the National Department of Health of Argentina, its object being to make investigations regarding the mosquitoes and other bloodsucking flies of the Southern Andes, and to form a general collection of insects from the southern beech-forests. Very little work had been done on the insect fauna of this region since the time of Philippi, whose results were published in the middle of last century, and it was believed that much of interest remained to be discovered, and that fresh collections might throw additional light on problems of distribution in the Antarctic regions.

Two and a half months, from October 1926 to January 1927, were devoted to collecting, most of the time being spent around Lake Nahuel Huapi, close to the western border of Argentina in latitude 41° S. From there the party worked their way across to the Chilean coast through extremely interesting and beautiful country. The route taken was the regular one over the Perez Rosales Pass and across Lakes Nahuel Huapi, Frias, Todos los Santos, and Llanquihué, an ancient route which is now being increasingly used by tourists. The scenery is varied with dense forests, fine waterfalls, and the snow-capped peaks of extinct and dormant volcanoes. On reaching the Chilean coast a short excursion was made to Chiloe Island, and the party then returned by the Chilean Longitudinal Railway and the Uspallata Pass to Mendoza.

In reply to remarks by Prof. R. R. Gates, Mr. W. S. Rowntree, Dr. A. B. Rendle, and Mr. J. Ramsbottom, the lecturer stated that the evergreen and deciduous species of *Nothofagus* overlapped a little in their altitudinal distribution. *Myzodendron* and *Cyttaria* were both found on *Nothofagus*.

There was insufficient evidence to settle the question whether the European Hare, that had been introduced, was displacing the native species.

The President expressed the thanks of those present to Mr. Edwards for his interesting account, and the meeting then ended.

2ND FEBRUARY, 1928.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 19th of January, 1928, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

The following were admitted Fellows:—William Kirk Bryce; Miss Frances Marion Lina Sheffield, M.Sc.

The PRESIDENT declared five vacancies in the List of Foreign Members of the Society, caused by the deaths of Professor G. B. Grassi, Professor Ludwig Radlkofer, Professor C. S. Sargent, Professor G. O. Sars, and Dr. Samuel Garman.

The President drew attention to the procedure to be followed as set forth in Chapter IV. of the Bye-Laws, and intimated that the Ballot would be held on the 3rd May, 1928.

The following candidate was balloted for and elected a Fellow:—Miss Mary Margaret Chattaway, M.A., B.Sc.

Major R. W. G. HINGSTON, I.M.S., gave an account, illustrated with a fine series of lantern-slides, of his observations on animal life on Mount Everest and the surrounding country.

Major Hingston accompanied the Mount Everest Expedition of 1924 as Medical Officer and Naturalist. Collections were made of the fauna and flora of the region traversed, and particular attention was given to the methods by which animals adapt themselves to the special conditions associated with high altitudes.

The environment of a lofty mountain-range differs from an environment at sea-level in certain fundamental particulars. These differences are mainly the lowness of temperature, the intensity of wind, the scarcity of food, the barrenness of the surroundings, and the rarefied condition of the air. In order to meet these changes in environment, the animals living at great heights have had to make special adaptations. These have usually been alterations in habit, but we also find modifications in structure.

Altitudinal distribution was specially studied. Fishes and reptiles ascended to 15,000 feet. A varied assemblage of mammals, birds, insects, and spiders was collected at 18,000 feet. Moths, butterflies, and humble-bees were carried by wind-currents to 21,000 feet. Birds followed the climbers up to 27,000 feet.

The highest plant was taken at 19,000 feet. Small spiders were found living permanently at 22,000 feet.

The President congratulated Major Hingston on the great interest of his account and the beauty of his photographs. He suggested that the spiders found at 22,000 feet lived on insects blown by wind up to that height. He recalled Murray's observations on the life found in freshwater pools in the Antarctic and on the resistance of creatures like Rotifers and Tardigrades to extremes of heat as well as of cold.

Mr. H. N. Dixon mentioned that Dr. Somervell had collected a Moss at 19,800 feet and Lichens at considerably over 20,000 feet.

Major Hingston, in reply, agreed with the President that chance-blown insects probably formed the food of the spiders found at 22,000 feet.

Mr. W. T. SAXTON described the life-history of *Lunularia*, with special reference to the archegoniophore and sporophyte.

Fertile plants of *Lunularia* are very rarely met with, but Mr. Saxton had secured male plants once and female plants on various occasions, and had obtained a sufficiently close series of sporophytes to trace their development with reasonable accuracy.

Lantern-slides of photographs, photomicrographs, and drawings were shown, illustrating fertile plants with mature archegoniophores and sporophytes, and a number of stages in their development. It was shown that the course of development of the sporophyte was rather strikingly different from that of any other member of the Marchantiales. The earliest stages in the development of the archegoniophore were not seen, but these were described and figured by Leitgeb between forty and fifty years ago, and copies of his drawings were shown.

The structure of the sessile antheridiophore is similar to that of *Fimbriaria* and several other Marchantiaceæ.

The first divisions in the sporophyte up to the 16-celled stage are quite normal, and the formation of foot and seta from the basal half proceeds as usual, but the divisions in the apical half are exceedingly regular and constant: and the formation of a single group of elongated sporogenous cells, dividing for some time by longitudinal walls only, is a unique feature. The only other Liverwort known to approximate to this arrangement is *Frullania*, one of the higher members of the Acrogynous Jungermanniales.

In reply to questions by Dr. E. J. Salisbury and Dr. E. J. Collins, Mr. Saxton stated that he had failed to detect fungal filaments in either fertile or sterile plants, and that he had no recollection of seeing gemmæ-cups on fertile plants.

Mr. A. G. LOWNDES exhibited a fine fruiting specimen of *Conocephalum conicum* (L.) Dum.

Professor R. S. ADAMSON (Visitor) exhibited a series of lantern-slides illustrating the vegetation of the eastern part of Southern Rhodesia. The major divisions of the vegetation were described and correlated with climatic and physiographic features. The types of vegetation mentioned and pictured were:—(1) Savannah Forest; (2) Grassland; (3) Riverside Forest; (4) "Flat-top *Acacia*" Forest, on mountain slopes; (5) Subtropical Rain-Forest; (6) Montane Grassland.

Mr. E. G. Baker drew attention to the desirability of good specimens of leguminous species and especially of *Acacia* being collected from Rhodesia.

The President expressed the thanks of the meeting to Professor Adamson for his interesting paper, and the meeting ended.

16TH FEBRUARY, 1928.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 2nd February, 1928, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read for the first time:—John Humphrey Bell, Maurice Arthur Holden Tincker, M.A.(Cantab.), M.Sc.(Lond.), and Miss Sidnie M. Manton, M.A.(Cantab.).

Professor F. E. WEISS, F.R.S., exhibited some photographs of young plants of *Euphorbia canariensis* raised by himself. He had observed that some plants had four rows of leaves represented by their spiny stipules; in the others there were only three rows of leaves. It was noticeable that in the first the ridges on which the spines were produced ran in straight vertical rows, whereas when only three rows of leaves were formed a distinct spiral arrangement was observed. The ridges on the lateral branches were also either in threes or fours. In the latter these were straight; in the former the lateral branches showed a spiral twist. It would appear as if the larger number of ridges rendered the stem mechanically more efficient, and the same result was secured where there was a smaller number of ridges by the spiral twisting of the stem.

Mr. E. HERON-ALLEN, F.R.S., gave an account, illustrated with photographs and lantern-slides, of the further researches of Joseph Jackson Lister, F.R.S., F.L.S., upon the reproductive processes of *Polystomella crispa* (Linn.).

The following is an abstract of the paper:—

At the time when the late J. J. Lister's paper on the production of microspheric young by the conjugation of flagellisporos emanating from the megalospheric form of *P. crassa* and other Foraminifera (read in 1894) was in process of publication in the Phil. Trans. of the Royal Society, he was engaged at Plymouth in further researches, as a result of which he was enabled to establish the production of megalospheric young by viviparity in the microspheric form. He left a succinct account of his work in MS., which does not appear ever to have been published, although a highly condensed account of the matter was added in 1895 as a postscript to his Phil. Trans. paper, and subsequently referred to in his Presidential Address to Section D at the British Association Meeting at York in 1906. Mrs. Lister having presented Lister's preparations for incorporation in the Heron-Allen & Earland Collection now in the Natural History Museum, and having entrusted Mr. Heron-Allen with the examination and custody of his scientific papers and laboratory note-books as part of the collection, his unpublished paper was read, and annotated with further information from his note-books. A very remarkable series of photomicrographic lantern-slides prepared by Lister for his York Address, showing the entire process hour by hour and often minute by minute, also presented by Mrs. Lister to the H.-A. & E. Collection, was exhibited.

The President agreed with Mr. Heron-Allen that Mr. Lister's researches on *Polystomella* were of fundamental importance, and that the remarkable series of photographs shown demonstrated the correctness of his main conclusions. He thanked Mrs. Lister (who was present) for the great service she had done to future workers by giving her late husband's specimens and note-books, with valuable material representing other groups of animals, to the Natural History Museum.

Professor E. W. MacBride gave reminiscences of Lister when both were working at the Marine Laboratory at Plymouth. He commented on the paucity of microspheric forms compared with the megalospheric. Mr. Heron-Allen suggested that this might be due to the fact that microspheric forms originated only from the conjugation of flagellate young from different individuals.

Dr. W. T. Calman endorsed the President's tribute to Mrs. Lister's generosity, and mentioned that, thanks to Mr. Heron-Allen, the British Museum possessed now what was probably the finest collection of Foraminifera in the world.

Mr. M. A. C. HINTON gave an account, illustrated with lantern-slides, of the stranding of a school of False Killer-Whales (*Pseudorca crassidens*) in the Dornoch Firth on the 18th October, 1927, and of an expedition which he made with Mr. P. Stammwitz and Mr. J. L. Chaworth-Musters in order to study the whales

and collect material for the British Museum. The species was first described from fossil remains from the Lincolnshire Fens by Owen in 1846, and first recognized as a living form by Reinhardt in 1862. Although traces of the species have been found in many parts of the world, our information about its external characters has been very meagre.

The school which entered the Dornoch Firth was a large one; the Museum party actually dealt with 145 individuals. In all probability others were stranded at the same time, but the carcasses were swept into deep water by the tide and lost. Owing chiefly to tidal action the party had to deal with a chain of dead whales extending from the mouth of the Firth to the head of the Kyle of Sutherland, a distance of about thirty miles. Most of the whales were carefully measured, their stomach-contents examined, and parasites, internal and external, collected; practically all the females were dissected for information as to breeding. With the help of local labour the whales were flensed, and the skeletons prepared and despatched to the Museum. Two individuals, a full-grown bull and a large cow, were sent entire to London, where plaster-casts were made from them. Numerous dissections have been made and 143 skeletons collected and cleaned. It is believed that when this material is worked out, it will throw much light upon various problems connected with the breeding, rate of growth, and longevity of whales, which still await solution.

The President commented on the enterprise shown in securing the skeletons of practically the whole school of *Pseudorca*. He believed that Mr. Hinton's study of this unique material would result in a distinct advance of our knowledge of the Cetacea in general, particularly with regard to such points as the alteration of skull-characters with increasing age and the differences between male and female skulls. He referred to the practical value of the arrangements made, some years ago, with the Admiralty and the Board of Trade, by which prompt information is given to the British Museum of the stranding of Cetacea on the British coasts.

Dr. W. T. CALMAN, in the absence of the author, gave the following résumé of a paper by Mrs. L. HUNTER (communicated by Professor W. J. DAKIN) on the Alcyonaria of the Abrolhos Islands.

This is an addition to the papers of the Abrolhos Islands Expedition which have been previously communicated to the Society, and deals with the Alcyonaria which were collected by Professor Dakin in his second expedition. A detailed account of the Islands was communicated to the Society by Professor Dakin on the 5th May, 1920.

There are twenty-four species, eight of which are new and nine of which are represented by new varieties. The two specimens

of *Pennatula* were described by Professor Hickson in 1922. Representatives of the Order Alcyonacea predominate, the majority being species of the Nephthyidæ. The Orders Stolonifera and Gorgonacea are represented, but *Heliopora*, usually abundant on other coral-reefs of the Indian Ocean, is absent.

Forms of phylogenetic and taxonomic importance are present. The creeping membrane in the specimens of *Xenia* provides a link between the Orders Stolonifera and Alcyonacea. The three species of *Eunephthya* supply a link between the lobose members of the Alcyoniidæ and the tree-like forms of the Nephthyidæ. The new species of *Agaricoides* confirms Simpson's statement that the genus is closely connected with *Lemnalia*. The close resemblance of the specimens of *Alcyonium* has led to the inclusion of a number of old species of *Alcyonium* as varieties of the old-established species *Alcyonium sphaerophorum*. The spicules found on *Sarcodictyon tropicale*, the first species of the genus to be recorded in warm waters, are of remarkable interest, since the *Sarcodictyon* has incorporated in some way the silicious spicules of the tetractinellid sponge upon which the specimen is creeping.

1ST MARCH, 1928.

Dr. A. B. RENDLE, F.R.S., Vice-President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 16th February, 1928, having been circulated, were taken as read, and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time in favour of John Humphrey Bell, Maurice Arthur Holden Tincker, and Miss Sidnie M. Manton. For the first time in favour of William Thomas Mathias, James Stirling, Miss Annie A. Irving, and Conrad Theodore Green.

Certificates of recommendation for election to Foreign Membership were read for the first time in favour of the following:—Thore Gustafsson Halle, Chief of the Palæobotanical Department, Naturhistoriska Riksmuseum, Stockholm; Robert A. Harper, Professor of Botany, Columbia University, New York; Axel Johan Einar Lönnberg, Chief of the Vertebrate Department, Naturhistoriska Riksmuseum, Stockholm; Thomas Wayland Vaughan, Director of the Scripps Institution of Oceanography, La Jolla, California; Friedrich Zschokke, Professor of Zoology, University of Basel.

Mr. A. M. SMITH, M.A. (Visitor), gave an account, illustrated with a series of lantern-slides, of his investigations of the Algæ of a bog, continued over a period of five years.

Observations were taken at approximately monthly intervals of the algæ of a small *Sphagnum* bog near Bradford from March 1923 to August 1927. Observations of the temperature and of the pH values of the water were also made. Two main algæ associations were clearly distinguished: (1) the association of the *Sphagnum* pools, and (2) the association of the mud pools and deeper ditches. The association of the *Sphagnum* pools had *Zygogonium ericetorum* and *Microspora floccosa* as co-dominants, and *Cylindrocystis Brebissonii*, *Tetmemorus levis*, *Staurastrum punctulatum*, *Edogonium rufescens*, *Sphærocystis Schroeteri*, *Merismopedia glauca*, *Oscillatoria tenuis*, and *Navicula* spp. as the characteristic subordinate species. The association of the mud pools and deeper ditches had *Mougeotia* sp., *Mougeotia viridis*, *Microspora tumidula*, and *Microspora stagnorum* as its dominants, and *Mougeotia parvula*, *Closterium striolatum*, *C. rostratum*, *Hormidium subtile*, and *Tabellaria floccosa* as its chief subordinate species. After the drainage of the bog in 1923 the *Sphagnum* association decreased, and the long, slow choking of the bog channels which followed later was accompanied by the gradual extension of this characteristic association. The total quantity of alga in the bog varied with the quantity of water in the bog, and showed little evidence of any check due to low temperatures. The quantity of certain species, however (e.g., a sterile species of *Mougeotia*), showed signs of diminution due to low winter temperatures.

Mougeotia viridis, *Cylindrocystis Brebissonii*, and *Edogonium rufescens* were frequently found in conjugation. *Mougeotia parvula* and *Closterium parvulum* conjugated rarely. The other species remained sterile.

Dr. A. B. Rendle commented on the great interest of Mr. Smith's investigations, and asked whether sexual reproduction in Algæ was associated with vegetative abundance, in contradistinction to what occurred in flowering-plants.

Professor F. E. Fritch referred to the work on the Algæ of *Sphagnum* pools that had been done on the continent. It had been shown that, when the pool was completely separated by peat from the underlying rock, a very restricted Desmid-flora, and one of remarkable constancy, was to be found. Mr. Smith's list of *Sphagnum* Algæ included only one of these Desmids, and it would be interesting to know whether he had obtained any data as to the depth of peat underlying his pools. Two of his commonest forms (viz., *Zygogonium ericetorum* and *Cylindrocystis Brebissonii*) were common soil-Algæ, and their abundance might be due to their occurrence on the surrounding surface. The violet granules in the sterile species of *Mougeotia* might be of the nature of Lagerheim's phycoporphyrin. The close correspondence between volume of water and quantity of Alga was striking, as this was by

no means always the rule—in fact, in lowland pools algal growth was often at its lowest when the pool was fullest. *Chrysopyxis bipes* was a new record for Great Britain.

Mr. J. C. Shenstone suggested that the brackish flats along the Essex coast offered a probably fruitful field for investigations similar to those carried out by Mr. Smith.

Mr. Smith, in answer to the comments offered on his paper, stated that conjugation amongst the Algæ was more abundant in places where a rich vegetative growth was favoured. He also expressed the opinion that conjugation might be influenced in any particular year by the weather conditions of the previous year.

Dr. C. Crossland, M.A. (Visitor), gave an account, illustrated with a series of fine lantern-slides, of the coral-reefs of Tahiti, Moorea, and Rarotonga. The following is an abstract of his paper:—

The reefs of Tahiti, in spite of their covering of coral and *Lithothamnion*, are not extending seaward. The sunk reefs are neither young reefs which have not yet reached the surface, nor reefs sunk by local subsidence, but are the eroded remnants of a surface barrier.

The lagoons have been excavated in an originally continuous reef, and subsidence is not necessary for the formation of barrier reefs. The adjacent island of Moorea has tilted and drowned its southern coast, with no effect on the form of the reefs. Lagoons and passes probably had their first origins in earth-movement radial and circumferential cracks opening in the reefs. Minor faulting in these directions is abundantly shown by the reefs. Half the passes are shallow, have no connection with the valleys which they may be near, and result from undermining of the reef from both ocean and lagoon sides.

In Moorea, which is a much smaller and older island than Tahiti, the reduced amount of alluvium brought down allows a more vigorous growth of coral in the lagoons, and the maritime flat is largely composed of coral and is not being washed away. On the ocean slope, however, there is little difference between the reefs of the two islands.

Flats of elevated coral occur in Moorea which afford another proof that there has been no recent seaward extension of the reef.

Rarotonga is usually described as having a fringing reef only, but comparison with Moorea suggests that it once had a lagoon which is now filled in.

Dr. Rendle commented on the interest of Dr. Crossland's paper, but the lateness of the hour left no time for discussion. Professor Matthai, however, expressed his support of Dr. Crossland's conclusion that the age of corals seemed to be passing away.

The following papers were read in title only :—

Dr. E. HANDSCHIN. Collembola from Mexico. (Communicated by Dr. A. D. Imms.)

Mr. W. O. HOWARTH, M.Sc. The Genus *Festuca* in New Zealand.

15TH MARCH, 1928.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 1st March, 1928, having been circulated, were taken as read and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

Certificates of recommendation of the following Candidates for Fellowship were read :—For the second time in favour of William Thomas Mathias, James Stirling, Miss Annie A. Irving, and Conrad Theodore Green. For the first time in favour of Stephen John Batchelder and Percy James Greenway.

Certificates of recommendation for election to Foreign Membership were read for the second time in favour of the following :—Thore Gustafsson Halle, Chief of the Palæobotanical Department, Naturhistoriska Riksmuseum, Stockholm ; Robert A. Harper, Professor of Botany, Columbia University, New York ; Axel Johan Einar Lönnberg, Chief of the Vertebrate Department, Naturhistoriska Riksmuseum, Stockholm ; Thomas Wayland Vaughan, Director of the Scripps Institution of Oceanography, La Jolla, California ; Friedrich Zschokke, Professor of Zoology, University of Basel.

The following candidates were balloted for and elected Fellows :—John Humphrey Bell, Maurice Arthur Holden Tincker, and Miss Sidnie M. Manton.

The PRESIDENT intimated that, including the candidates recommended for election, the list of the Society was now twenty-five short of the full number of 800 Fellows.

The PRESIDENT announced that on the 14th March, 1928, the Frank N. Meyer Medal for distinguished service in Plant Introduction had been presented to Mr. H. N. Ridley, C.M.G., F.R.S., F.L.S., in recognition of the important part he had played in establishing plantations of the Para Rubber Tree in the Oriental

Tropics. The presentation was made by the American Consul-General on behalf of Dr. David Fairchild, the President of the American Genetic Association, to whom the award is entrusted by the Staff of the Office of Foreign Plant Introduction, United States Department of Agriculture.

The PRESIDENT expressed the congratulations of the Society and Mr. Ridley briefly acknowledged them.

The PRESIDENT drew attention to the Seventh International Congress of Photography to be held in London from the 9th to the 14th July, 1928, and stated that intending members of the Congress should communicate with the Hon. Secretary, 35 Russell Square, London, W.C. 1.

Mr. I. H. BURKILL exhibited a tuber of *Dioscorea alata* L., with the shape of a horse-collar, newly received at the Royal Botanic Garden, Kew, from Mrs. D. J. Collins, of Sriracha, Siam. It was not abnormal, but one of the numerous cultivated races of this yam, a race found from the Philippine Islands westward to Siam and the Malay Peninsula.

He remarked that primitive man, painfully aware of the labour of digging for his food the tubers of the ancestral *D. alata* from three feet down, when he started to cultivate or to care for them selected for shortness, and so in time provided himself with rounded and variously-branched tubers of new races. But the elongated deep-burying yams remained the more tender and desirable. Rumpf tells how, in the island of Buton, a device had been arrived at for growing these deep-burying yams through horizontal bamboos placed close to the surface of the soil, that when wanted they might be got easily. In recurving yams, such as the one exhibited, nature had given man another means of saving his labour. When a set of one of them was planted, the new tuber started its growth downwards, recurved in the soil, and, unless earthed-up, extruded. When it extruded, its growth was liable to be stopped; but if earthed repeatedly it might be got to grow the season out, the positive geotropism with which it started having turned into a negative geotropism. Secondary tubers arising by the side of the first, and of course later, possessed negative geotropism from the beginning, and grew upwards. This geotropic change seemed worthy of investigation, and, as the race was to be cultivated at Kew, there would be an opportunity for anyone interested to investigate it.

Such recurving yams could not survive as wild plants: wild pigs would not allow them to do so. They certainly took their origin under cultivation.

Dr. J. BURTT DAVY, on behalf of Mr. D. F. Chesters, of the Nigeria Forest Service, exhibited a specimen of *Tectona grandis* Linn. f. from Burma, in which the corolla-lobes and stamens were

seven in number, instead of the five or six recorded in the books. All of the flowers examined from the specimen agreed in this particular.

Dr. J. BURT DAVY also exhibited, on behalf of Mr. P. J. Greenway, lately Herbarium Assistant, Imperial Forestry Institute, specimens of *Pyrola rotundifolia* L., from Bagley Wood, Berks. Although only two miles from Oxford, this appeared to be a new locality- and county-record for this species.

He also communicated a short paper by Mr. P. J. Greenway on the Forest Flora of South Central Africa, of which the following is an abstract :—

The author of the paper had occasion to identify herbarium specimens of forest-trees sent to the Imperial Forestry Institute from Northern Rhodesia and adjacent areas in the Katanga Province and Nyasaland. The work was done partly at Kew, with the kind permission of the Director.

Much of the material was collected by Mr. R. Bourne, of the Imperial Forestry Institute, while on a tour of inspection on behalf of the Northern Rhodesian Government. The time of year (July to September) was unfavourable for good botanical specimens, very little flowering material being obtainable. The collections represent 131 species, comprised in 80 genera and 34 families. The three families of Leguminosæ furnish the largest number of species: the Cæsalpiniaceæ contain 26, including two new species of *Brachystegia*; Mimosaceæ 9 species, of which five are Acacias; and Papilionaceæ 12 species. In the Myrtaceæ there is a new species of *Syzygium*.

Only two genera, *Monotes* and *Marquesia*, of the Dipterocarpaceæ are met with in tropical Africa; of the former there are several reputed specimens, which are fairly common in the dry savannah-forest. *Marquesia macroura* Gilg, the "Musesjie," is one of the most abundant trees in Northern Rhodesia and the Katanga, where it attains a height of 65 to 80 feet; the wood is described as very hard and of good quality, and is used for finishing houses and in carriage-building. In view of the great economic interest of the Dipterocarps in the Indo-Malayan Region, the African species are worth careful investigation.

Of especial interest is the occurrence of a species of *Hirtella* (Rosaceæ). This genus is chiefly American in its distribution, being represented by about 40 species in Central and South America; no representatives have yet been recorded from West Africa, but two are found in Madagascar, and one is described from East Africa, *H. zanzibarica* Oliver, which was figured in the 'Icones Plantarum' (xii. 81, t. 1193, 1876). To this single species from continental Africa should now be added a new species, and a third species, *H. bangweolensis* (Fries) Greenway, originally described under the name *Parinarium bangweolense* R. F. Fries (in Fedde, Report, xii. p. 540, 1913). Further

study of the African material of *Hirtella* in European herbaria is desirable, as it may prove necessary to separate it as representing a distinct genus.

Dr. S. W. KEMP (Visitor) gave a sketch of the history of whaling in both the northern and southern whaling-grounds, and an account, illustrated with a series of beautiful lantern-slides, of the work and aims of the 'Discovery' Expedition to the southern whaling-grounds. The following is an abstract of Dr. Kemp's paper:—

The principal object of the 'Discovery' Expedition is the study of whales and whaling in the Southern Hemisphere. The history of whaling in the north shows that species have been reduced, sometimes almost to the point of extinction, by methods far less deadly than those at present employed, and fears are naturally entertained that intensive whaling in the south must lead before long to the collapse of the industry. Experience indicates that when once a stock of whales has been seriously depleted, recovery, if it is ever effected, is a matter of centuries, and it follows that, if too many rorquals are taken in the south, there is a grave risk that a very important source of wealth will be destroyed. It is to be noted, however, that the actual extermination of any species of whale is most improbable under present conditions, for long before this point was reached commercial operations would cease to be profitable.

The main work of the 'Discovery' Expedition is to obtain information on whales and on the conditions which affect them, for with better knowledge of their life-history and habits better regulations for the control of the industry can be devised. At a shore laboratory, erected close to one of the South Georgian whaling stations, observations both statistical and anatomical are made on the whales themselves. From this work we can determine the time when breeding takes place, the length of the period of gestation, the rate of growth, the size and age at which the various species become mature, the kind of food they consume, and many other particulars of importance.

The two ships of the expedition, the 'Discovery' and the 'William Scoresby' have for the most part been engaged in research on the plankton and hydrography of southern waters with a view to obtaining precise information on the environment of whales. In the south whale-food appears to consist exclusively of a single species of *Euphausia* (a Crustacean related to the Decapods), and a study of this species and the reasons for its great abundance in certain parts of the Antarctic is one of the subjects to which special attention has been devoted. Hydrographic work, to determine the physical and chemical constitution of the water, has been undertaken in conjunction with the planktonic observations, and it is hoped that by a close study of all the conditions it may be possible to find the reasons for the great fluctuations that exist from one season to another in the abundance of whales.

The PRESIDENT thanked Dr. Kemp for his interesting communication and conveyed to him the best wishes of the Society for the complete success of the great scientific Expedition to which he was acting as Director of Research. He commented on the remarkable observation that the food of whales off South Georgia was practically confined to *Euphausia superba*, and suggested that this might be due to their preference for this particular diet when it is available, and that it did not necessarily imply that they would not take other food in its absence. He expressed his appreciation of this positive contribution to knowledge, as contrasted with the uncertainty which existed with regard to the nature of the food of other large Cetacea, as, for instance, the Greenland Whale. He called the attention of the Society to the remarkable insight which had been shown by William Scoresby the younger in appreciating the dependence of Whalebone Whales on plankton and in devising methods for its study, including its relations to hydrography.

Dr. E. J. ALLEN expressed his high appreciation of the very valuable scientific work being conducted by Dr. Kemp as head of the most important and most efficiently staffed expedition for the investigation of ocean-life that had been sent out from England since the time of the 'Challenger.'

29TH MARCH, 1928.

Dr. A. B. RENDLE, F.R.S., Vice-President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 15th March, 1928, having been circulated, were taken as read and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

Certificates of recommendation of the following Candidates for Fellowship were read:— For the second time in favour of Stephen John Batchelder and Percy James Greenway. For the first time in favour of Albert Denny Usher.

Certificates of recommendation for election to Foreign Membership were read for the third time in favour of the following:— Thore Gustafsson Halle, Chief of the Palæobotanical Department, Naturhistoriska Riksmuseum, Stockholm; Robert A. Harper, Professor of Botany, Columbia University, New York; Axel Johan Einar Lönnberg, Chief of the Vertebrate Department, Naturhistoriska Riksmuseum, Stockholm; Thomas Wayland Vaughan, Director of the Scripps Institution of Oceanography, La Jolla, California; Friedrich Zschokke, Professor of Zoology, University of Basel.

The following candidates were balloted for and elected Fellows:—William Thomas Mathias, B.Sc., James Stirling, B.Sc., Miss Annie A. Irving, B.Sc., Colonel Conrad Theodore Green, M.R.C.S., L.R.C.P., D.P.H., R.A.M.C. (Retd.).

The VICE-PRESIDENT intimated that the Rooms of the Society would be closed from 5 P.M. on the 5th April, 1928, to 10 A.M. on the 10th April.

He also drew attention to the exhibit of the vellum-sheet bearing the signature of HER MAJESTY THE QUEEN as Honorary Member of the Society: and to the exhibit of the Gold Medal of the Rubber Growers' Association and the Frank N. Meyer Medal which had been presented to Mr. H. N. Ridley.

Dr. A. B. RENDLE exhibited a specimen of a rhizome of *Piper methysticum* Forster, the source of "Kava." The species is a native of many of the Pacific Islands, where a stimulating and intoxicating drink is commonly made from it. The rhizome is chewed and the saliva ejected into bowls, in which it is allowed to ferment, or water is added, and the whole well stirred and strained. If the rhizome is triturated in cold water, a stimulating beverage is obtained, which, in Samoa, is often drunk even by Europeans in preference to tea. At the native ceremony of Kava-drinking, the drink is prepared by the "tapu" or chief's daughter, who, until she marries, is considered infallible. The rhizome is also known to have diuretic properties.

Dr. MALCOLM WILSON read a paper, by himself and Miss M. J. F. WILSON, on "The Dutch Elm Disease and its Occurrence in England," illustrated with lantern-slides. The following is an abstract of the paper:—

The Dutch Elm Disease was discovered in Holland in 1919, and during the same year in the north of France. The following year it was reported from all parts of Holland, and in 1921 was stated to be present throughout Belgium. In the same year it was recorded from western Germany, and since that date has spread over the greater part of that country.

It has recently been recorded from Norway, but the report has not been confirmed, and it does not appear to be present in Denmark or Sweden; according to verbal statements it is present in Spain and Italy. An outbreak of the disease was discovered near London last July.

Three explanations have been offered as the cause of the epidemic:—

- (1) It is due to the fungus *Graphium Ulmi* Schwarz.
- (2) It is caused by *Micrococcus Ulmi* Brussoff.
- (3) It is the result of unfavourable climatic conditions, i. e., drought and frost.

The most recent experimental evidence, published by Wollenweber, supports the first explanation, and this is generally accepted by the Dutch investigators. Brussoff considers that the disease also attacks other species of trees, but this has not been confirmed by other workers.

Trees suffering from the disease may be readily recognised by the yellow discoloration of the leaves in the crown of the tree or at the tips of the side branches. This condition usually spreads rapidly over the tree, and is followed by leaf-fall and, subsequently, by the death of the tree. Defoliation may be complete within a week, but sometimes extends over a much longer period. Infected branches, when cut across, show one or more rings of small brown spots in the most recently formed wood. These internal symptoms sometimes, but not invariably, can be found in the roots.

Culture work has been carried out with material obtained from Germany, Holland, and Britain, and the results show marked similarity. *Graphium Ulmi* was isolated in a large proportion of the cultures; in addition, bacteria, mainly cocci, were found in most of the liquid but not on the solid media.

The disease is present in epidemic form throughout most of western Europe, and shows no sign of becoming less virulent. No species of *Ulmus* grown in Holland appears to be immune, and the situation is so serious that the Dutch authorities have now discontinued the planting of elms. No adequate method of control has yet been discovered, but removal and destruction of trees in the early stage of infection may check the spread of the disease.

Dr. G. H. Pethybridge considered that the most important new point emerging from Dr. Wilson's interesting discourse was the fact, announced for the first time, that the coremial fructifying stage of the fungus *Graphium Ulmi*—now considered to be the real cause of the disease—had been found to occur on dead twigs of the host. They were now therefore no longer completely in the dark as to the source from which infection of healthy trees might occur. It was equally important to discover the mode and time of infection, for with such knowledge it would be more easy than it was at present to formulate control measures on an intelligent basis. He understood that the Forestry Commission had decided to undertake a survey in regard to the disease as soon as the time arrived when symptoms would again become visible, and he alluded to some of the difficulties that might be encountered in securing and diagnosing suitable material. With regard to the Order, promulgated in 1926 by the Ministry of Agriculture, prohibiting the importation of living elm-trees from the continent of Europe into England and Wales, to which allusion had been made, and which Dr. Wilson regarded as having been made too late, Dr. Pethybridge pointed out that the powers under the Destructive Insects and Pests Acts in regard to forest-tree diseases and pests formerly exercised by the Ministry were assumed by the Forestry Commission when this body came into

existence in 1919. Although this Commission did not exercise its own powers in this instance, it appealed to the Ministry to make the Order, and the request was promptly complied with. The Order thus came into force at least a year and a half before any case of the disease was observed in England. Dr. Wilson's and Miss Wilson's continued investigations on behalf of the Forestry Commission would undoubtedly be of great service to that body in its endeavour to exterminate the disease, or at least restrict its spread.

MR. R. W. BUTCHER and MR. F. T. K. PENTELOW (Visitor) gave an account, illustrated with lantern-slides, of their investigations into "The Effect of Pollution on the Ecology of a small Stream." The following is an abstract of their paper:—

An ecological study has been made during the past two years of the River Lark in West Suffolk. This is a small river, which was made navigable about 1700, but is not now used by boats, save in the very lowest portion. As a result, in its upper reaches, the bed of the stream is too large for the volume of water, and much silt has been deposited. This is very much overgrown with plants such as *Sparganium erectum* and *Glyceria aquatica*, usually associated in the littoral zone of ponds and lakes.

The other river-plants may be easily divided according to the velocity of the current, and therefore to the nature of the river-bed. In non-silted reaches *Ranunculus fluitans* and *Enanthe fluviatilis* are dominant. In silted portions *Potamogeton lucens* and *Sparganium simplex* are the commonest plants. The sessile or bottom-living diatoms are very abundant in the spring, and *Enteromorpha* and *Cladophora* occur in the slow stretches in the summer.

From September to February a beet-sugar factory empties into the river about four million gallons of waste waters a day. This water contains much organic matter and so deoxygenates the river-water, *e.g.*, at one station the oxygen fell from 110 per cent. to 19 per cent. saturation. There is also an increase in the ammoniacal nitrogen.

The effect of these waste waters on the flora is to increase the number of bacteria and cause very large growths of "sewage fungus," of which *Sphaerotilus natans* is by far the commonest.

The fauna of the river may be divided into three definite ecological associations—the *Gammarus* type occurring everywhere among the weeds and among stones and gravel on the bottom, the *Sialis-Sphaerium* type occurring on the bottom in muddy stretches, and the *Chironomid-Tubificid* type which occurs in very foul mud. The occurrence of these associations is dependent on the amount of oxygen in the water in which the animals live. *Gammarus* requires a large amount of oxygen, *Sialis* and *Sphaerium* require very much less, and *Chironomids* and *Tubificids* can exist practically without oxygen. The effect of pollution,

therefore, on the fauna is due to the reduction of oxygen, and results in the encouragement of *Sialis-Sphaerium* and *Chironomid-Tubificid* associations at the expense of the *Gammarus* type.

Dr. E. S. Russell commented on our scanty knowledge of the ecology—both plant and animal—of small streams, and paid tribute to the excellent work by Messrs. Butcher and Pentelow. He drew attention to the fact that there was a small laboratory at Alresford for freshwater ecological investigations, and invited assistance in the work being carried on there.

Dr. E. J. Salisbury emphasised the important scientific aspect of Messrs. Butcher and Pentelow's work, which was one of the first attempts to investigate intensively and simultaneously the fauna and flora of the same area. The separation of the bottom-flora into "silt" and "non-silt" floras did not take cognisance of the importance of the relative proportions of mineral and organic matter in the silt. In the swifter reaches the conditions were greatly complicated by the slowing-down effect of the plants themselves, which might act as submerged dune-formers.

Dr. W. Rushton congratulated the authors on their valuable contribution to the ecology of stream-life and the marked effect of a single pollution. He was not quite certain about the absence of oxygen and the occurrence of the sewage fungus, *Sphaerotilus natans*, as in his experience this fungus occurred in streams below jam works, distilleries, etc., the fungus not appearing to full perfection until the organic matter of the effluent came in contact with fully-aerated waters. He would have liked more information on the effect of the decay of the masses of vegetation apart from the effluent from the beet-sugar factory.

He was surprised to find fish-life present, even coarse fish, in waters so deficient in oxygen. He did not think the evidence as regards the *Sialis* group convincing, as one could find many forms on practically every stone in the upper reaches of Devonshire and Yorkshire streams where pollution was non-existent.

In regard to the return of trout to such a stream or even the existence of a single specimen, it was difficult to see how they could exist at all under the conditions stated.

The authors of the paper, in their reply, stated that the quantity of "sewage-fungus" bore no relation to the oxygen-content of the stream. Trout occurred in reaches where there was always a certain amount of oxygen, and could in any case go up the tributaries, which were free of pollution. In the event of the pollution becoming excessive, they would probably not return to the main stream. *Elodea canadensis* was not mentioned, as it did not occur in the Lark. It was not possible to separate out natural vegetation decay from the effects of pollution, as both started at the same time of the year.

The following paper was read in title only :—

Mr. C. C. A. MONRO, F.L.S. Polychæta of the Families Polynoidæ and Acetidæ from the Vicinity of the Panama Canal, collected by Dr. C. Crossland and Dr. Th. Mortensen.

19TH APRIL, 1928.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 29th March, 1928, having been circulated, were taken as read and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

The following were admitted Fellows:—Miss Mary Margaret Chattaway, Frank Young Henderson, and Eustace Cecil Barton-Wright.

Certificates of recommendation of the following Candidates for Fellowship were read :—For the second time in favour of Albert Denny Usher. For the first time in favour of Aldewin Cecil Ibbotson, Alec Ernest Haarer, and John Macqueen Cowan.

Certificates of recommendation for election to Foreign Membership were read for the fourth time in favour of the following :—Thore Gustafsson Halle, Chief of the Palæobotanical Department, Naturhistoriska Riksmuseum, Stockholm; Robert A. Harper, Professor of Botany, Columbia University, New York; Axel Johan Einar Lönnberg, Chief of the Vertebrate Department, Naturhistoriska Riksmuseum, Stockholm; Thomas Wayland Vaughan, Director of the Scripps Institution of Oceanography, La Jolla, California; Friedrich Zschokke, Professor of Zoology, University of Basel.

The PRESIDENT intimated that the ballot for the election of Foreign Members would be held on Thursday, the 3rd May, 1928.

The following Candidates were ballotted for and elected Fellows :—Stephen John Batchelder and Percy James Greenway.

In accordance with Chap. X. Sect. VII. of the Bye-Laws, the following were nominated Auditors of the Treasurer's Accounts for 1927-28, and elected by a show of hands:—

Representing the Council	{ Dr. E. J. Butler. Mr. R. Cory.
Representing the Fellows	{ Mr. E. T. Browne. Mr. R. Paulson.

Mr. R. D'O. Good gave an account, illustrated with lantern-slides of maps, of the Geographical Distribution of the Sino-Himalayan genus *Cremanthodium* (Compositæ). The following is an abstract of his account:—

The genus *Cremanthodium*, as considered here, consists of about fifty species, and is probably the largest genus strictly confined to the Himalayas and western Chinese mountains. It is mainly an ecological and geographical genus, comprising the high-alpine derivatives of the genus *Ligularia*, itself almost entirely an eastern Asiatic genus and very closely related to *Senecio*.

The range of *Cremanthodium* is roughly within the triangle made by joining the Indus valley where it enters the N.W. Frontier Province, Lake Koko Nor in Kansu, and Lake Tali-fu in Yunnan. This total area is divisible into three main topographic regions, the western or Himalayan mountains, the eastern or western Chinese mountains, and the plateaux of Tibet.

A statistical study of the distribution of the species shows that:—

- (1) 14 species are found in both western and eastern mountains.
- (2) 4 species are found only in the Himalayan mountains (all in the eastern half of the range).
- (3) 30 species are found only in the Chinese mountains (almost all in the southern half).
- (4) The greatest concentration of species is in Yunnan.
- (5) Only two or three species extend on to the Tibetan plateaux.

Geological evidence indicates that mountains of considerable height have existed in western China during the whole of Angiosperm history, but that the Himalayas have been raised much more recently, at most since the Miocene, and that the elevation may still be going on.

The present areas of greatest species population in the genus are within the zone of very high monsoon precipitation, but this distribution results largely from the configuration of the mountains, and the elevation of the Himalayas has probably caused the progressive desiccation of the northern mountains of western China.

These considerations of present distribution, geology, and climate suggest that the history of the genus *Cremanthodium* has

been somewhat as follows:—The genus originated from *Ligularia* in the southern part of the western Chinese mountains, at some period not more recent than the early Miocene, and spread northwards along the mountains until a number of the wider species reached Kansu. The elevation of the Himalayan mountains then began, and resulted in the interruption of the source of the rainfall in the northern Chinese mountains, the Himalayas themselves becoming a zone of very high rainfall along which the genus spread rapidly as far as the Indus valley. The changed climatic conditions checked, and perhaps even diminished, the range of the genus in the northern part of the Chinese mountains, but the southern part was unaffected and continued to produce numerous new species.

Dr. A. B. Rendle recalled the reference in his last Presidential Address to the comparative scarcity of monographic papers, and expressed his pleasure in listening to Mr. Good's paper, which was the result of work, not merely on material in this country, but also on material in Continental herbaria. He asked if Mr. Good had found any relation between the range of the genus and its morphological characters.

Mr. R. Paulson, referring to Mr. Good's mention of one species that was found in small quantity on the Himalaya and in great quantity in S.W. China but with the line of distribution unbroken, stated that some species of Lichens, such as *Letharia flexuosa*, believed, since 1848, to be endemic to the Himalaya, had recently been collected in N.W. Yunnan, but, so far, with a gap in the distribution. It was possible that, as more collections were received, gaps in the distribution of the higher plants might be filled up.

In reply, Mr. Good stated that the species of the Tibetan plateaux were more hairy, and those of the western China hills somewhat sturdier, than those from other areas. There was no break in the distribution of those species which have both an eastern and western distribution.

The President referred to the general theme of the paper as being of interest to zoologists as well as to botanists.

Professor F. O. BOWER discussed the influence of the Size-Factor in Plant Morphology, with special reference to the stele, his remarks being illustrated with lantern-slides. The following is an abstract:—

The Principle of Similarity has been applied freely to the structure of the animal body. Botanists have been slower in applying it to plants. Nevertheless, the practicable limit of size of trees has long ago been discussed by mathematicians, and it is recognized that a change either of material composing the woody trunk or of the method of its construction would be necessary for effective growth beyond the limits already reached by some of them. About 300 feet is approximately the level of the highest canopy in tropical forests.

The mechanical application is, however, only one of the ways in which the Principle of Similarity affects organic structure. Its relation to physiological interchange commands a greater interest, since with increasing size, if the form be unchanged, the surface will increase as the square, while the bulk will increase as the cube of the linear dimensions. Physiological interchange is conducted through limiting surfaces, external or internal. It may be assumed that, provided the surface be unbroken, such interchange will be proportional to the area of the surface involved. Accordingly, in an enlarging body, if the original form be retained, a practicable size-limit will ultimately be reached. But any change from a simple form which makes the surface more complicated increases the proportion of surface to bulk: for instance, corrugation, or fluting, or branching, and segregation into parts. Increasing morphological complexity, which involves such progressive changes, may be held as a concession to physiological requirement in a growing organism. The size-factor which favours such results is only one among many that have influenced form. Nevertheless, a recognition of morphological results which do, in point of fact, accord with the demands of increasing size should help to make comparative morphology a rational study.

In the construction of any ordinary vascular plant, there are three important limiting tissue-surfaces:—(i.) the outer contour, complicated though it usually is in subaerial plants by the added cell-surfaces lining the ventilating channels; (ii.) the endodermal sheath, which delimits the primary conducting tracts from the enveloping tissues; (iii.) the collective surface by which the dead tracheal system faces upon the living tissues that embed it. This is apt to be complicated by intrusion of living cells into the dead tracts. Each of these is a surface of physiological transit; each independently of the others will be a suitable subject of observation from the point of view of the proportion of surface to bulk as the size increases.

The discussion dealt only with (ii.) and (iii.). In order to make it precise, all secondary or cambial developments were ruled out, and only primary structure as it is seen in relatively primitive plants dealt with. The common form of axis in primitive plants is conical, enlarging upwards; and the conducting system enlarges with the axis. Thus it will constantly be called upon to meet a diminishing proportion of surface to bulk. The demonstration consisted in tracing through numerous examples how this is actually carried out. The chief changes are these:—

- (a) Penetration of the primitively solid tracheidal tract by living cells, or replacement of those that are central by parenchyma.
- (b) Its enlargement of surface by fluting, or segregation into parts.

- (c) The involution of the endodermis, which is apt to follow the changes in the tracheidal tract, but does not always do so.

Illustrations were taken from the Psilotales and Psilophytales: the Lycopodiales and the Filicales, &c., and also from the roots of these, and from Angiosperms.

One of the leading results that follows from the comparison of the conducting tissue in these plants is, that the stele may react to the size-factor independently of the insertion of appendages. This is seen in marked degree in roots; it is also evident in aphyllous and microphyllous forms, but where the appendages are large these exercise a correspondingly great influence upon the stelar development. Thus the stele appears to have an adaptive morphology of its own, and the evidence of its independence varies with the relative insignificance, or dominance of its appendages.

Dr. G. P. Bidder welcomed Professor Bower's able exposition of the most important principle of Biology—that of Similarity, with its relation of the square and the cube.

In animals also we find that with increasing size absorptive surfaces have to change their design to keep pace with the increase in bulk. Obvious cases are the sacculation of the lung and the lengthening and coiling of the intestine, with the accompaniment of convexity of the abdomen in the larger mammalia. The principle is far more important in animals than in plants, for dynamics come in as well as statics. From the first increase in size from the Protozoa upwards, all the evolution of aquatic animals has been governed by the relation between the volume of the protoplasm, which produces movement, and the area of external surface exposed to the resistance of water, while the evolution of land-animals has been governed by the relation of weight to cross-section of muscles, bones, and tendons.

Dr. D. H. Scott said he had listened with great pleasure to Prof. Bower's lucid statement. He had no criticisms to make, for he quite agreed with the author as to the importance of the size-factor in morphology; that it was not the *only* factor was evident and indeed implied in the title of the paper. Prof. Bower had ruled out secondary thickening, and he was not going to discuss it. In some of the cases cited, however, notably *Sphenophyllum*, Nature had complicated the question by superadding a secondary zone, perhaps more important than the primary structure. He had been especially interested in the remarkable experiment of Prof. Bower's colleague in changing the anatomical structure of the stem of *Selaginella Lyallii*. The account of the tubers of *Nephrolepis* also appealed to him, as he had once made some observations on the stolons of that genus.

As regards the remark quoted by Prof. Bower on species of *Heterangium* and *Lyginopteris*, this referred to the work of Dr. Kubart, the Austrian palæobotanist, whose results had not yet been

published in full. *Heterangium Andrei*, the species with very parenchymatous wood, was certainly a large plant for a *Heterangium*, and approached *Lyginopteris* in anatomical habit. The other transitional species, *Lyginopteris heterangioides*, was of no great size. Numerous specimens, however, would have to be compared before any conclusions as to relative dimensions could be drawn.

Mr. W. C. Worsdell expressed great interest in Prof. Bower's exposition, which had thrown new light upon facts that hitherto had been stated merely as facts without explanation.

The President, in expressing the thanks of the meeting to Prof. Bower, paid tribute to his power of arousing enthusiasm in new lines of research and to the great interest of his paper to zoologists no less than to botanists.

The following paper was read in title only:—

Mr. W. H. THORPE, B.A. Biological Races in *Hyponomeuta padella* Linn. (Communicated by Professor J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

3RD MAY, 1928.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 19th April, 1928, having been circulated, were taken as read and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table.

The following were admitted Fellows:—Miss Annie A. Irving and Macgregor Skene.

Certificates of recommendation of the following Candidates for Fellowship were read for the second time:—Aldewin Cecil Ibbotson, Alec Ernest Haarer, and John Macqueen Cowan.

The following Candidate was balloted for and elected a Fellow:—Albert Denny Usher, B.Sc., F.C.S.

The PRESIDENT declared the five vacancies in the List of Foreign Members, and the Candidates proposed for the vacancies. The ballot was then held, and the following were elected Foreign Members:—Thore Gustafsson Halle, Chief of the Palæobotanical Department, Naturhistoriska Riksmuseum, Stockholm; Robert

Almer Harper, Professor of Botany, Columbia University, New York; Axel Johan Einar Lönnberg, Chief of the Vertebrate Department, Naturhistoriska Riksmuseet, Stockholm; Thomas Wayland Vaughan, Director of the Scripps Institution of Oceanography, La Jolla, California; Friedrich Zschokke, Professor of Zoology, University of Basle.

The PRESIDENT announced that the Council had awarded the Linnean Gold Medal to Professor Edmund Beecher Wilson, Columbia University, New York, United States of America.

The ASSISTANT-SECRETARY drew attention to an error in the notice of the Anniversary Dinner, the date having been printed as Tuesday the 24th May instead of Thursday the 24th May.

Dr. A. B. RENDLE called attention to an appeal by Dr. John Briquet, Director of the 'Conservatoire Botanique' of Geneva. The 'Conservatoire' was founded in 1824, and the first two Directors were Augustin Pyramus and Alphonse de Candolle. In 1870 it was enriched by the gift of the important Delessert Herbarium, and has recently acquired, by gift from the representatives of the family, the classical de Candolle Herbarium, one of the most important in the world for taxonomic work; the de Candolle Library, which is inseparable from the Herbarium, has also been acquired.

The expense of building the 'Conservatoire' and its successive enlargements has been borne by the City of Geneva, which also provided nearly 250,000 francs for the installation of the de Candolle Herbarium and the purchase of the Library. But the old Commune of Geneva, with barely 60,000 inhabitants, is unable, under present unfavourable financial conditions, to support the additional burden imposed by the upkeep of the de Candolle collections. Dr. Briquet is, therefore, making an effort to raise a capital fund of 200,000 Swiss francs, the income from which should suffice for the upkeep of the Herbarium and Library, and for publications. The fund would be administered by a Committee of Trustees.

The International Education Board, founded by J. D. Rockefeller, Jun., has promised a contribution of two-thirds of the amount as soon as the remaining third has been collected, and an appeal for the required sum—66,666 Swiss francs—has been issued by the Council of the Fund, of which Dr. Briquet is Secretary, and is warmly recommended by a long list of botanists in all parts of the world.

The appeal should have a special interest for Fellows of the Linnean Society, and the Council has agreed that donations may be sent to the Society to be forwarded in due course to Geneva. Cheques, payable to The Linnean Society of London, should be sent to the Assistant-Secretary.

Mr. T. A. SPRAGUE, by permission of the Director of the Royal Botanic Gardens, Kew, exhibited living plants in flower of *Pinguicula caudata* and *P. Bakeriana*. The orchid-flowered Butterworts (*Pinguicula*, Sect. *Orcheosanthus* A. DC.), to which the specimens belong, have a flat corolla limb with hardly any tube and with a long spur. Their flowers recall those of some Balsams or Orchids. All the species of the section *Orcheosanthus* show seasonal dimorphism of the leaves, winter-rosettes of numerous small non-carnivorous leaves alternating with summer-rosettes of relatively few large carnivorous ones. The specimen of *P. caudata* had a winter-rosette in the centre of which a few summer leaves were developing, while the specimen of *P. Bakeriana* was in the summer condition. Flowering occurs in either winter or summer states. The species may be propagated by means of adventitious buds formed on the winter-leaves when the latter are detached.

Dr. AGNES ARBER exhibited flowers of the orange-brown variety of the Cowslip, described in Hooker's 'Students' Flora' as rare. A single plant of this variety had been found in a copse at Whittlesford, Cambridgeshire, and had been planted in a garden, where it had always come true to colour.

Dr. D. H. Scott mentioned that the same form had also been found near Basingstoke.

Dr. G. S. CARTER (Visitor) gave an account, illustrated with a fine series of lantern-slides, of the investigations made by Mr. L. C. Beadle and himself into the bionomics of the swamps of the Paraguayan Chaco. The following is an extract of his paper:—

The Paraguayan Chaco is a plain stretching westwards from the Rio Paraguay towards the Andes. A belt within 100 miles of the river consists partly of grassland, in many places covered with large numbers of a palm, *Copernicia cerifera*, and partly of a dry and thorny woodland. In the more open parts of the grassland are large areas of shallow swamps. To the west the country becomes much drier and the swamps and palms cease.

Dr. G. S. Carter and Mr. L. C. Beadle investigated the bionomics of these swamps, during a visit to the country in 1926-7. Analyses were made of the water with the object of studying several of its physical characteristics. For comparison with these, other fresh waters in the district were also analysed.

During the summer months the climate is distinctly tropical, and the nature of the water most largely influenced by the amount of the rainfall. The most striking result of the analyses was the evidence that they gave of the small amount of oxygen present in the water at all times. It appeared that the co-operation of several conditions, such as the absence of disturbance and the large amount of decay in the water, produced this result. The

oxygen-content was so low as certainly to play a determining part in the control of the fauna.

Investigation of the fauna showed that many forms were adapted in various ways to life in a medium poor in oxygen. This was especially clear with the fishes and the oligochaetes.

It was suggested that in many other shallow tropical fresh waters it would be found that the supply of oxygen for respiration is the factor in the environment of the greatest bionomic importance to the fauna.

Mr. C. Tate Regan said he was especially interested in the air-breathing fishes, but suggested that the bubbles of the nest of *Callichthys* might be for flotation, as in the foam-nest of the Asiatic genus *Betta*.

Dr. G. P. Bidder commented on the remarkable absence of oxygen at a depth of six inches, and enquired whether there was any evidence of colouring-matter being developed for the storage of oxygen.

The President expressed the thanks of the meeting to Dr. Carter, and read a letter to himself from Professor Graham Kerr, in which it was stated that the investigations carried out by Dr. Carter and Mr. Beadle would constitute a very important extension of our knowledge both as regards the special region of the Gran Chaco and the conditioning factors of life in freshwater swamps in general. The President also referred to the great interest of Dr. Carter's remarks on *Lepidosiren* to the older zoologists, in whose younger days it was looked upon as one of the rarest of living animals.

Dr. Carter, in reply to the appreciations of his paper, suggested that the land-travelling habit of some tropical fishes was secondary to the adaptations for air-breathing, and that the motion of the pelvic filaments of the male *Lepidosiren* might bring a certain amount of oxygen to the young in the nest. He had noticed no evidence of colouring matter being developed for the storage of oxygen.

Miss LILIAN LYLE related her experiences in investigating the marine algæ of some of the German warships sunk in Scapa Flow, and of the neighbouring shores, her remarks being illustrated with lantern-slides of some of the ships and of some of the algæ. The specimens were gathered at low tide and from varying depths down to 72 feet. The flora of the wrecks was mostly Orcadian, but some algæ hitherto known only from the Baltic were also found. Submergence for eight years greatly militated against the chance of finding many foreign specimens, and possibly specimens of other species had arrived with the vessels but had died off under the changed conditions.

Mr. A. D. Cotton congratulated the author on the success of her investigations and on the discovery of additions to the British and Orkney flora.

One of the most interesting algæ from the point of view of distribution was *Codium mucronatum* var. *atlanticum*, a conspicuous species which could not easily be overlooked. This plant occurs apparently only on the north and west coasts of Scotland and the north and west coasts of Ireland. *C. mucronatum* in other forms is widely distributed on the Pacific coast of America and in Australia and New Zealand. Whether the British form be regarded as a distinct and endemic species, or as an alien introduced many years ago, its strictly limited distribution in Europe, confined to the western part of the British Isles, was remarkable and unique among algæ.

Dr. Ethel Delf referred to the few opportunities of such investigations as Miss Lyle had conducted and the great interest of her paper to algologists, and asked whether observations of the light-intensities at different depths had been made. Miss Lyle, in reply, stated that it had not been possible to record the light-intensities.

The President drew attention to the small amount of information available regarding the distribution of organisms by ships, and suggested that there was scope for investigation in this direction in harbours.

Dr. HELENA BANDULSKA described, with the aid of lantern-slides, a Cinnamon from the Bournemouth Eocene.

Dr. D. H. Scott recalled that many Laurineæ flourished in past ages in this country, and expressed his appreciation of the excellent results gained by the most recent methods of investigation.

Mr. H. W. Monckton contrasted the imperfect information alone available in the old days with the precise knowledge now possible of attainment. He suggested that the leaves described by Dr. Bandulski were probably from drifted plants.

24TH MAY, 1928.

Anniversary Meeting.

Sir SIDNEY F. HARMER, K.B.E., F.R.S., President,
in the Chair.

The Proceedings of the previous meeting, held on Thursday the 3rd May, 1928, having been circulated, were taken as read and confirmed.

A statement of the donations received since the previous meeting was read and laid on the table, among them being a water-colour painting, by Mr. S. J. Batchelder, of Mousehold

Heath, Norwich, presented by the artist's son. This is interesting to the Society from the Founder's pious recollections of the slopes overlooking Norwich.

The following were admitted Fellows:—Stephen John Batchelder and Maurice Arthur Holden Tincker.

Certificates of recommendation of the following Candidates for Fellowship were read for the first time:—James Percy Tufnell Burchell, Miss Daphne Aubertin, and Malcolm Arthur Smith.

The following Candidates were balloted for and elected Fellows:—Aldewin Cecil Ibbotson, Alec Ernest Haarer, and John Macqueen Cowan, B.A.(Oxon.), M.A., D.Sc.

The Treasurer presented his Financial Report and the Accounts of the Society, duly audited, for the year 1927-28. On a motion by Dr. G. C. Druce, F.R.S., seconded by Mr. C. D. Soar, the Report and Statement of Accounts were adopted.

The Bye-Laws regulating the Election of Council and Officers having been read by the Assistant Secretary, the PRESIDENT declared the Ballot for Council and Officers to be open, and voting began.

The Assistant-Secretary and Librarian presented his Report as follows:—

During the Session, 3rd November, 1927, to 24th May, 1928, there have been held 14 meetings of the Society, including the Anniversary Meeting, 10 meetings of the Council, and 7 of the Library Committee.

At the 13 Scientific Meetings of the Society, 29 papers were read, of which 14 were botanical, 10 zoological, and 5 of general biological interest. In addition, 3 zoological and 1 botanical paper were read in title only. There were 12 exhibits during the Session, 11 being botanical and 1 historical. Of the 15 botanical papers, 4 were systematic, 4 floristic, 2 ecological, 1 distributional, 1 historical, and 1 each concerned with respectively pathology, development and structure, and the Size-factor and Principle of Similarity in plants. Of the 13 zoological papers, 7 were more or less systematic, 1 phylogenetic, 1 faunistic, 1 physiological, 1 on coral-reefs, and 2 on Whales. The total attendances of Fellows, Associates, and others at the scientific meetings, so far as the signature sheets record, were 1043. The attendances at individual meetings varied from 66 to 104, the lowest attendance being on

the 15th Dec., 1927, and the highest on the 5th Jan., 1928, the average being 80. The average attendance of Fellows and Associates was 61, and 19 of visitors.

From the 25th May, 1927, to the 24th May, 1928, the number of names that have disappeared from the List of the Society is 32, being 19 Fellows, 2 Foreign Members and 1 Associate by death, 8 Fellows by withdrawal, and 2 Fellows by removal.

The detailed statement is as follows :—

Deceased.

FELLOWS.—Robert Miller Christy, Henry Arthur Erlebach, Charles Ford, Jules Augustin de Gaye, Peter Goyen, Linnæus Greening, Thomas Howse, Benjamin Daydon Jackson, John Rudd Leeson, John Talbot Dillwyn Llewelyn, Gervase Mathew, George Peddie Miln, John Clark Newsham, William Charles Frank Newton, Campbell Patrick Ogilvie, Edward Augustus Petherick, Arthur Everett Shipley, William Andrew Shoolbred, and Edgar Ravenswood Waite.

FOREIGN MEMBERS.—Wilhem Ludvig Johannsen and Samuel Garman.

ASSOCIATE.—George Charles Champion.

Withdrawn.—George Thomas Bethune-Baker, Francis Rosslyn Courtenay Bruce, Robert Edward Chapman, Miss Ethel Mary Doidge, George Henry Aidan Elrington, Miss Dora Lawson, John Lloyd Williams, and Frank Wall.

Removed in accordance with the Bye-Laws, Chap. II., Sect. VI.
—Thomas James Evans and Zenon Ioannon Solomides.

On the 15th December, 1927, Her Majesty the Queen graciously honoured the Society by becoming an Honorary Member, and signed the Signature Book on the 29th March, 1928, thus bringing the number of Honorary Members up to two.

During the Session, and including the Anniversary Meeting, 40 Fellows have been elected and 1 Associate, the latter filling the vacancy caused by the death of Miss Matilda Smith. Of the 40 Fellows elected, all except 5 have qualified, which makes an addition of 35 for the year plus 1 Fellow who was elected during 1926-27 but qualified only in 1927-28, and 1 Fellow who was removed last year but has since been re-instated, or a total of 37. Deducting from this the total loss of 29 Fellows during 1927-28, the net addition to the List of Fellows for the year is 8.

The List of Foreign Members has been brought up during the year to its full number of 50. There is still one vacancy in the List of Associates.

On the 24th May, 1928, the numbers on the List of the Society are as follows :—

	MEN.	WOMEN.	TOTAL.
Honorary Members	1	1	2
Fellows	658	113	771
Foreign Members.....	50	—	50
Associates	23	1	24
TOTALS	<u>732</u>	<u>115</u>	<u>847</u>

One candidate elected during last year and 5 during 1927-28 still have to qualify, and are not included in the above List.

During the year 5 numbers of the Society's Journal have been published, 3 botanical and 2 zoological, comprising 12 botanical and 6 zoological papers.

LIBRARY :—From the beginning of 1927-28 the Library has become one of the 49 Outlier Libraries working in conjunction with the Central Library for Students, and as a result of this connexion has received for the year a grant of £666 13s. 4d. from the Carnegie United Kingdom Trust. In all, £1260 14s. 5d. has been spent on books, periodicals, and binding. The details are given under Library Account in the Statement of the Treasurer's Account. In contrast with the 51 volumes chronicled as additions during 1926-27, the additions during 1927-28 comprise 185 works purchased and 110 books and reprints presented.

The number of books borrowed between the 1st May, 1927, and the 30th April, 1928, is 1225 by 193 individual borrowers, including the Central Library. Of the total, 53 were borrowed by the Central Library, leaving 1172 as borrowed by 192 Fellows and Associates, or an average of 6 books per borrower per annum, or fewer than two books per annum per Fellow and Associate of the Society as a whole.

In the same period the number of visits to the Library, so far as can be calculated from the signature book, is 1052, of individual visitors 291. On the 51 Saturday afternoons during the period, 65 visits were made by 41 individual visitors. These figures show that so far there is no risk of the Library suffering from congestion by visitors. There is, however, a decided congestion of work, which it is beyond the power of the very limited official staff to relieve. In these conditions the voluntary help rendered by Mr. James Robson for a considerable part of the year has been of great assistance.

Mr. Spencer Savage and Mr. W. S. Warton have as usual given acceptable service to the Society in their respective posts throughout the year.

At the conclusion of the Assistant-Secretary's report, the PRESIDENT appointed Mr. A. W. Sheppard, Lt.-Col. J. H. Tull Walsh, and Professor F. E. Weiss, F.R.S., as Scrutineers of the Ballot.

The President then read the following account of the scientific researches of Professor E. B. Wilson, of Columbia University, New York, to whom the Linnean Gold Medal had been awarded, and thereafter handed the Medal to Mr. Boylston Beal, Counsellor of Embassy of the United States of America, for conveyance to Professor Wilson, who was unavoidably absent.

The Council of the Linnean Society have this year awarded the Linnean Medal to Professor EDMUND BEECHER WILSON, of Columbia University, New York, to express the high appreciation of the Society of the value of his contributions to Biological Science, especially in connexion with Cytology and Experimental Embryology.

In 1883 Professor Wilson published an important paper on the development of the Alcyonarian, *Renilla*; and his earlier investigations were concerned with descriptive embryology. His interests soon turned towards the experimental side of that subject, and during the last decade of the century he took a noteworthy part in building up the new science of Experimental Embryology. Working with Echinoderms he made a masterly series of observations on the behaviour of the egg under experimental conditions, thus elucidating the normal processes of fertilization and the phenomena of artificial parthenogenesis. His study of the segmentation of the eggs in *Nereis*, *Dentalium*, and other forms clearly defined the true significance of mosaic development; and his experimental work has thus thrown important light on the theory of cytoplasmic differentiation and of organ-forming stuffs. He has devoted much attention to the study of cell-lineage, and his paper on *Nereis* is a classical analysis of the development of the Trochophore larva.

Wilson was one of the first to realize the importance of the sex-chromosomes, and from 1905 to 1912 he produced a long series of papers on this subject. The relations of the chromosomes to sex, particularly in Insects, were here exhaustively studied. In 1914 he delivered the Croonian Lecture of the Royal Society, on "The Bearing of Cytological Research on Heredity." Zoologists are specially indebted to him for his classical text-book on 'The Cell.' This was first published in 1896 and it gave an admirable survey of a rapidly growing subject. A greatly enlarged Third Edition, consisting of over 1200 pages, was published in 1925. Encyclopædic in treatment, it sums up the state of knowledge at the time of its publication in all that concerns the cell in its relation to development and heredity. Scholarly and judicial, it is absolutely fair and trustworthy in its exposition of theories, and it is quite indispensable to all workers in this varied field. It is no mere compilation, but it is a masterpiece of building, in

which all the threads of the complicated story are woven into a coherent tissue. It could have been written only by a veritable master of his subject.

The impression produced by the study of Wilson's work is that he has grasped clearly the major problems of cytology, and has attacked them on original and effective lines. His arguments are always pertinent and his critical ability stands out clearly when he is analysing apparently conflicting data.

In 1911 Professor Wilson became a Foreign Member of our Society. We now ask him to accept the Linnean Medal, the highest honour we have to award.

Mr. Boylston Beal having responded on behalf of Professor Wilson, the President delivered his Address (see p. 51). On its conclusion Dr. D. H. Scott, F.R.S., moved "That the President be thanked for his excellent Address, and that he be requested to allow it to be printed and circulated amongst the Fellows." The motion was seconded by Professor E. W. MacBride, F.R.S., and being put to the Meeting was carried by acclamation.

The Ballot having been closed, the Scrutineers retired with the lists, and after examination reported to the President, who declared the result as follows:—

COUNCIL FOR 1928-29.—Dr. G. P. Bidder; Mr. I. H. Burkill; Dr. E. J. Butler, C.I.E., F.R.S.; Dr. W. T. Calman, F.R.S.; Dr. E. J. Collins; Mr. A. D. Cotton; Mr. G. R. de Beer; Mr. H. N. Dixon; Mr. F. Druce; Dr. Philippa C. Esdaile; Professor J. Stanley Gardiner, F.R.S.; Professor R. R. Gates; Sir Sidney F. Harmer, K.B.E., F.R.S.; Miss G. Lister; Professor Doris L. Mackinnon; Mr. H. W. Monckton, V.-P.G.S.; Professor J. Percival; Mr. John Ramsbottom, O.B.E.; Dr. E. S. Russell; Dr. E. J. Salisbury.

(The retiring Councillors were Mr. R. Cory, Dr. R. T. Gunther, Miss A. C. Halket, Professor E. W. MacBride, F.R.S., and Dr. A. B. Rendle, F.R.S.)

OFFICERS FOR 1928-29.—*President*: Sir Sidney Frederic Harmer, K.B.E., F.R.S.; *Treasurer*: Mr. H. W. Monckton, V.-P.G.S.; *Zoological Secretary*: Dr. G. P. Bidder; *Botanical Secretary*: Mr. John Ramsbottom, O.B.E.

The President then announced that he appointed the following as VICE-PRESIDENTS for 1928-29:—Dr. W. T. Calman, F.R.S.; Mr. H. N. Dixon; Mr. H. W. Monckton, V.-P.G.S.; Dr. E. J. Salisbury.

Thereafter the President declared the Session of 1927-28 closed.

PRESIDENTIAL ADDRESS,

24TH MAY, 1928.

BY SIR SIDNEY F. HARMER, K.B.E., Sc.D., F.R.S.

ONE of my first thoughts, on being chosen to occupy the distinguished position of President of the Linnean Society, was connected with a feeling of local patriotism. As a native and citizen of Norwich I could hardly fail to remember that two of our earliest Presidents were specially connected with that city. Sir James Edward Smith, Founder of the Society and its first President (1788-1828), was also a native of Norwich, where he died in 1828. Our fourth President (1837-1849) was the Rt. Rev. Edward Stanley, Bishop of Norwich.

Her Majesty the Queen has graciously consented to join the Society as an Honorary Member, during the Session which is just completed, and this event has afforded special satisfaction to all its ordinary members.

I do not propose to recapitulate the Obituary Notices which, unfortunately, form a normal part of our 'Proceedings,' and I refer merely to the fact that we have sustained great losses during the past year. The names of Benjamin Daydon Jackson, A. D. Michael, E. R. Waite, G. C. Champion, Sir Arthur Shipley, and J. E. Harting, who had been Fellows or Associates of the Society, and of W. L. Johannsen and Samuel Garman, Foreign Members, call for special mention. These had rendered notable service to the Society or to Science, and we are united in deploring their loss.

I feel that I can choose no subject more suitable for a Presidential Address to a Society representing both Zoology and Botany than one which emphasizes our duty to use whatever influence we may possess in preserving the fauna and flora of the world. The settlement and cultivation of virgin land involves the disappearance of some of the native animals and plants; and, however much this may be regretted on scientific grounds, it seems necessary to accept some of the results as inevitable. The establishment of Nature Reserves in many parts of the world is an indication that public opinion is becoming alive to the importance of preventing unnecessary extermination. Much might be said about the excellent work which is being accomplished by Governments and Societies in this direction, but I must restrict myself to the consideration of human agency in depleting the numbers of animals and plants whose existence is in no way prejudicial to the interests of civilisation.

A species which is represented by few individuals in any locality is in danger of extermination if it is not protected from unnecessary destruction: and in our own Islands, for instance, steps have to be taken for preventing, if possible, the complete disappearance of rare animals and plants. Many species are

threatened owing to the fact that they are of commercial importance. On the Botanical side there is no subject which gives rise to more serious anxiety than the rapid reduction of the forests of the world. Timber is a prime necessity for mankind, though we may doubt whether some of the uses to which wood-paper is put can be held to justify the destruction of enormous areas of forest. In the colder parts of the world warm clothing cannot be dispensed with, but the demand for furs is endangering the existence of many species of Mammals. If we grant, as I think we must, that these and other natural products are necessary for our existence or comfort, we must at least demand that the resources of Nature should not be squandered, and that every effort should be made to preserve for posterity the advantages we ourselves enjoy. There can be no doubt that we are not doing our duty in this respect. Timber is being cut without regard to the fact that the annual consumption is larger than the replacing growth; and insufficient attempts are being made to grow new trees. The operations of the collector of furs are guided by his own personal advantage, or by that of his employers, and he does not as a rule pause to consider whether he is helping to reduce the number of the animals he hunts.

In this class of cases it is clear that the interests of science and of commerce ought to be identical; and the best hope for the future appears to be a rational alliance between naturalists who wish to preserve a species for its own sake and those who, although they are engaged in operations which threaten the existence of species, are willing to admit that it is a poor policy to kill the goose which lays the golden eggs. It is in this spirit that I wish to consider the special subject of my Address.

HISTORY OF WHALING.

The first decade of the present century saw the inception of whaling enterprises in a previously untouched area, the Dependencies of the Falkland Islands, on a scale never previously reached; and the question has arisen whether these operations are endangering the future of the species of Whales concerned.

This subject has already been discussed, during the present Session, by Dr. Stanley Kemp, the Director of Research to the 'Discovery' Expedition, in an admirable account he gave us of the work which has been carried on under his leadership. The Expedition has been undertaken by the Government of the Falkland Islands, under the auspices of the Colonial Office, in order to obtain all possible information about whales—with the principal object of ascertaining what would be the best way of protecting them if it were to be proved that new restrictions had become necessary. Dr. Kemp has already told you that the whaling Companies are giving every possible assistance to this enterprise. It is not to be expected that they would welcome legislation which would restrict their immediate profits, but it may

be anticipated that the more responsible companies at least would adopt a reasonable attitude with regard to proposals for dealing with admitted dangers. Serious difficulties would be likely to arise in connexion with the operations of Companies unwilling to submit to any restraint, and these could probably be surmounted by nothing less than an International agreement.

I need not conceal my personal conviction that the destruction of whales is at present too high, and I base this conclusion on history. New whaling fields have from time to time, in the past, been visited by whaling fleets, attracted by the immense numbers of whales frequenting them; and the course of events has shown a singular resemblance in all localities. In the earlier years of each enterprise, whales have been plentiful and usually near the land: and their capture has been comparatively easy. The successful results of the pioneers have attracted competitors, and the size of the fleet has continued to increase up to a certain maximum. This has led to a decrease in the number of whales, which have had to be sought further and further from the coast, and it has become difficult for a ship to secure a cargo sufficient to make its operations profitable. The fleet has accordingly become smaller, but this has not arrested the diminution of the whale-population—and this decline has continued to an extent resulting in the abandonment of the industry. No case is known in which the whale-population has been re-established to anything like its former size, even after the cessation of whaling during a long series of years. It is clearly uneconomic to allow the number of whales to decrease beyond a certain point in any locality.

In the following pages I give some of the evidence which justifies the above statements. It must first be remarked that, with certain exceptions, the same kinds of whales occur in the neighbourhood of both Poles, but that it has not been finally decided whether the northern and southern schools really belong to the same species. I assume, for the purposes of this address, that the Rorquals and Humpbacks of the two Hemispheres are not distinct. If this is correct, nearly all the whaling of the world, past and present, has been concerned with 10 or 11 species:—three or four species of Right Whale, the Pacific Grey Whale, the Humpback and four species of Rorqual, all Whalebone Whales; and the Sperm Whale, a Toothed Whale.

1. *Biscay Whale, North Atlantic Right Whale or Nordkaper*
(*Balæna glacialis*).

The history of whaling naturally begins with this species, which was hunted by the Basque inhabitants of the Biscay coasts of France and Spain. The industry was important as early as the twelfth century, as is shown by documentary evidence. It is believed to have been going on for a considerable time before that period, probably from the 10th or 11th century, at least.

The Biscay Whale is one of the "Right Whales," which are characterised by the absence of a dorsal fin, and it can thus be recognised in the ancient armorial bearings of the town of Lequeitio, for instance. It need not be assumed that no other species were killed by the early whalers, but this was at least one of them. Like most other Cetacea, the Biscay Whale is a migratory animal, and it formerly appeared close inshore on the Basque coasts during the winter and early spring months. Compared with the results of modern whaling, the numbers caught appear to have been very small. Sir Clements Markham* has published records extracted from the archives of the town of Lequeitio, including the details of the catch for 1517 to 1661. The total, for the first 100 years of this period, is only 35. If this is a fair average of the captures of at least 20 villages, the total for a century, along the Spanish part of the coast, would appear to have been not more than 700-1,000. Even this limited hunting seems to have produced the effect of driving the whales from the coast, a conclusion which is supported by the fact that the Basque sailors found it necessary to undertake long voyages, in pursuit of whales, about the middle of the 17th century, or even earlier. A few whales appear to have been killed, however, on these coasts as late as the end of the 18th century †. Since 1800 the Biscay Whale has hardly been known to occur there, although a female of this species, accompanied by her calf, entered the harbour of San Sebastian in 1854. Some of the old watch-towers, situated on eminences overlooking the sea, from which the early whalers first sighted their prey, may still be recognised. A watchman who tried to use them for their original purpose would now have an unprofitable occupation, and he would not be likely to see a single whale of this species during a lifetime.

The Basque whaling ships which replaced the smaller boats originally used for shore-whaling no doubt extended their range by degrees, but as early as the 16th century they had reached Newfoundland, where their example was followed by the ships of other nations. Anthony Parkhurst, in a letter dated 1578 ‡, mentioned the average number of vessels which at that time annually visited Newfoundland and the neighbouring banks. There were about 50 English vessels, nearly as many Portuguese, 150 French, 100 Spanish and about 20 or 30 *whaling ships* from Biscay. It is thus obvious that part of the energy of this fleet of nearly 400 ships was devoted to whaling, although most of it was probably concerned with fishing and sealing. In 1594 the 'Grace of Bristol' found at Newfoundland the wrecks of two large Biscayan whalers, from which they took 700-800 pieces of whalebone §; and about 1705 fifty or more whales might be seen at once in

* Proc. Zool. Soc. 1881, pp. 971, 972.

† *Ibid.* p. 972.

‡ Eschricht and Reinhardt, 1866, p. 16 n.

§ *Ibid.* p. 17.

the St. Lawrence. Dr. Glover M. Allen*, in the course of a valuable summary of the occurrence of the Biscay Whale in New England waters, and of the Right Whale "fishery" in the same district, informs us that "the Right Whale and less often the Humpback were the only species regularly hunted in our waters until the introduction of more deadly apparatus than the hand harpoon, so that it may usually be assumed that when 'whales' are mentioned in the old accounts as seen or pursued, the Right Whale is the species intended." He states that at the time of the settlement of New England, and for nearly a century afterwards, Right Whales were present in considerable numbers, in the shallow waters of the S.E. coast of New England, from late autumn to spring. Twenty-nine whales were killed in one day in Cape Cod Bay about January 1700, and in 1726 the total catch was 86; but the evidence that these were all Right Whales does not appear to be conclusive (see p. 61). After this time whaling decreased in that district and was ultimately abandoned.

The Icelanders seem to have engaged in whaling, in their own waters, independently of the Basques, and the whale designated as "Sléttibaka" in the "Kongespeil" (ca. 1250) is believed to have been the Biscay Whale. Whales were caught by the Norwegians off the Tromsø coast as early as the 9th or 10th century, and a report made by Ottar to King Alfred on his voyage of discovery, about 890, towards the White Sea is the earliest information we have on the subject†. About 50-60 whaling ships visited Iceland annually during the 16th century. The industry flourished specially from 1596 to 1622 between the North Cape and Bear Island, with whaling stations at Hammerfest and elsewhere, but it began to decline at this time, partly because there were fewer whales, but also owing to the fact that the attention of the whalers was becoming diverted to the Greenland Whale.

The Biscay Whale has thus been successively hunted in the Bay of Biscay, in the neighbourhood of Newfoundland and New England, off Iceland, and to the north of Norway during a period of at least 700 years (1100-1800). In all the localities in question its numbers diminished, the industry terminating about 1700 on the European side of the Atlantic and about 1800 on the American side‡. It had become excessively rare, and for many years it was believed to be extinct.

About 1850 the Biscay Whale began to re-appear, with an occasional stranding on the Atlantic Islands or the north coast of Spain, and by 1880 it had become the object of a moderate whaling industry off the Eastern United States. Some ten years later a few individuals began to be caught by Norwegian vessels off Iceland and the Farøe Islands; and since that time an appreciable number have been taken by whaling stations off the West of Ireland and the Outer Hebrides.

* Allen, G. M., 1916, p. 132.

† Collett, R., 1912, p. 547.

‡ *Ibid.* p. 548.

Prof. D'Arcy Thompson* has recorded the catches made by the Scottish stations from 1908 to 1914, during which 67 individuals were killed, an average of nearly 10 a year; and he mentions 18 individuals captured by the Irish stations from 1908 to 1910. Nearly the whole of the Scottish catch was made in the months of June and July (principally June). The Biscay Whale, like others, is found further north during the summer than in the winter and spring, when it was formerly captured in the Bay of Biscay.

There is thus undoubted evidence that the Biscay Whale has to some extent recovered in number, as the result of a century or so of immunity from pursuit. It does not seem to have reached anything like its former abundance, there is not sufficient evidence that it has re-established itself in the Bay of Biscay, and it certainly does not frequent the coastal waters of the Basque Provinces.

2. *Greenland Whale* (*Balæna mysticetus*).

This magnificent animal surpasses all other whales in efficiency as a plankton-feeder, its mouth and the baleen-sieve which it contains being of prodigious size. It is described in Natural History works of the last century as "The Common Whale," a designation which is unfortunately no longer applicable. It is more polar in its occurrence than any other of the great whales, since it appears never to go far from the edge of the northern ice, nor to undertake extensive migrations into warm water during its breeding period.

The Greenland Whale (a Right Whale) was unknown to science until a late period, although it is described in the "Kongespeil," to which reference has been made above (p. 55). Its more modern discovery is due to the whalers who had penetrated far to the north in pursuit of the Biscay Whale, when that animal was no longer to be captured in sufficient numbers further south. Its general history has been described by Eschricht and Reinhardt†, who first established clearly the occurrence of two species of Right Whale in northern waters. In 1611 Thomas Edge was sent by the English Muscovy Company on the first whaling expedition which went to Spitsbergen. His instructions included descriptions of two kinds of Right Whales (the Biscay Whale and the Greenland Whale), the existence of which had been known to the Basques at an earlier date‡. The first Greenland Whale is said to have been killed in Grand Bay, Newfoundland, although it seems to be uncertain whether there is any later record of the occurrence of the species in that locality. The Greenland Whale had an extraordinarily high commercial value. Its

* Thompson, D'A. W., 1918, p. 200.

† Eschricht and Reinhardt, 1866, pp. 3 *et seq.* ‡ *Ibid.* p. 22.

baleen sold at one time for as much as £2,250 a ton*, and a large individual might produce a ton and a half of this material, besides nearly 30 tons of oil. The ships used in 1820 were of about 250-400 tons, and it was possible at one time for a small vessel of this kind to cover its expenses for an entire season out of the proceeds of a single whale.

It is thus not surprising that the Spitsbergen industry developed with great rapidity after 1611; and the conflicting interests of different nations soon give rise to international difficulties. Our own country was early engaged in conflicts with the Dutch, and in 1618 it became necessary to divide the coast of Spitsbergen—the use of different bays being reserved for the English, Dutch, Danes, Hamburgers, and Biscayans. The Dutch had already at that time made use of Jan Mayen as a whaling station. All the early whaling ships were obliged to employ Basques, who were well acquainted with the difficulties of the pursuit.

Our knowledge of the Greenland Whale is largely based on William Scoresby's great work, 'An Account of the Arctic Regions,' published in 1820. His career was so varied and unusual that I think some details of it may be of interest to the Society. The father, also William Scoresby, of this remarkable man was one of the most noted whaling Captains of his time. William Scoresby the younger† was born in 1789, and he made his first whaling voyage, in his father's ship, at the early age of 10. He went back to school after the return of this expedition, and in 1806 he entered the University of Edinburgh, where he studied Chemistry, Natural Philosophy, and Anatomy. A year later he volunteered for service with the Fleet at Copenhagen and was put in charge of a gunboat, which he brought back to England at the end of the year. In 1809 he resumed his studies at Edinburgh, and in 1810 he became Captain of the 'Resolution,' previously his father's whaling ship. His success as a whaler may be judged by the fact that his cargo of 1820 was the largest which had ever been brought from Greenland to Liverpool. On returning from his last whaling voyage in 1823 he resolved to take Orders, entering at Queens' College, Cambridge, as a "ten years' man," towards the end of that year. In 1824 he was elected a Fellow of the Royal Society, and he was ordained in 1825, in which year he commenced his work in the Church as a Curate. He took the Degree of B.D. (Cambridge) in 1834 and D.D. in 1839, when he became Vicar of Bradford, Yorkshire. He resigned this office in 1847 owing to ill-health, but in 1856 he undertook a voyage to Australia, for the purpose of carrying out magnetic observations—a subject in which he had previously made important advances. His health finally broke down while he was preparing his results for publication, and he died at Torquay in 1857.

* Southwell, T., 1906, *Trans. Norf. and Norwich Nat. Soc.* viii. p. 209.

† Scoresby-Jackson, R. E., 1861; *see also* 'Dictionary of National Biography,' li. 1897, p. 6.

I shall be forgiven, I hope, for making this digression from my main subject, but the intrinsic interest of the 'Arctic Regions,' one of the most remarkable books in the English language, is increased by knowing something of the life of its author. We are fortunate in having an account of the Greenland Whale written by so talented a man. The work in question is rightly described in the 'Dictionary of National Biography' as the foundation-stone of Arctic science. Scoresby's temperament was thoroughly scientific, and he touches no subject which he does not illuminate. A large part of our knowledge of whaling is based on the evidence of untrained observers, but in consulting Scoresby we are sure that any account he gives of his own observations is trustworthy, and we are impressed by his scientific acumen and the clarity of judgment with which he handles his material.

The conditions under which the industry was carried on when Spitsbergen was first visited by whalers may be described in Scoresby's own words * :—"At this time, the mysticetus was found in immense numbers throughout the whole extent of the coast, and in the different capacious bays with which it abounds. Never having been disturbed, these animals were unconscious of danger, and allowed themselves to be so closely approached, that they fell an easy prey to the courageous fishermen. It was not necessary that the ships should cruise abroad throughout the extended regions of the Polar Seas, as they do at the present time; for the whales being abundant in the bays, the ships were anchored in some convenient situation, and generally remained at their moorings until their cargoes were completed. Not only did the coast of Spitzbergen abound with whales, but the shores of Jan Mayen Island, in proportion to its extent, afforded them in like abundance."

This state of things did not continue. The whales "took the alarm and gradually receded from their favourite haunts" †. They seem to have become scarce in the bays about 1630-1640, but they remained for a time plentiful along the coast. They could still be towed into harbour and the blubber could be boiled on shore; but as the whales increased their distance it became necessary to take the blubber on board, and the ships could enter port only occasionally. The blubber had to be packed in casks and the oil was extracted at home, after the conclusion of the voyage. The factory buildings in Spitsbergen had become useless, and Scoresby remarks ‡ that several of them were still to be found in 1671. The whales continued their retreat "to the banks at a distance from land, then to the borders of the ice, and finally, to the sheltered situations afforded by the ice" §, a process which appears to have been completed about 1700-1720.

The "immense herds" in which the whales at first appeared "encouraged the hope that the profitable nature of the fishing would continue unabated" ||, but it soon proved that the whaling

* Scoresby, 1820, ii. p. 172.

† *Ibid.* p. 178.

‡ *Ibid.* p. 180.

§ *Ibid.* p. 181.

|| *Ibid.* p. 52.

had reached its acme, and it began to decline so rapidly from 1636-1637 that the losses of certain companies on some occasions exceeded their former profits. The charters which had been granted to the Dutch Greenland Companies expired in 1642, and up to this time these chartered companies had sent out about 30 ships annually. On the removal of the monopoly the number rose to 200-300*. Before 1642 the whaling at Jan Mayen, where whales had formerly occurred "in vast profusion," had also attained its maximum: and after this time the industry began to fall into decay, and Jan Mayen was at length abandoned altogether†.

The cessation of whaling off Spitsbergen and Jan Mayen did not, however, involve the extinction of the industry. In 1719 the Dutch sent ships to Davis Strait, and from this time a large proportion of the whales appear to have been captured on the west side of Greenland. Scoresby's figures are mostly given as totals of the number of ships employed in the "Greenland" and "Davis Straits" areas. The extent of the industry may be judged from his table‡ of the number of English and Scotch ships engaged on the two sides of Greenland from 1750-1788. In 1750 there were 20 ships, but the number rose, specially towards the end of this period, to 253 in 1788. The size of the catch was very small compared with those which are being captured in the south at the present time. On p. 72 Scoresby mentions the capture of 7 whales by a London ship in 1736 as a successful result, and he records the taking of 857 whales by 191 Dutch vessels, an average of not quite $4\frac{1}{2}$ whales for each ship. The largest cargo landed in Britain up to 1820 was made, in 1814, by the 'Resolution,' which procured 44 whales, from which 299 tons of oil were extracted§. As Scoresby stated elsewhere|| that a large whale might produce nearly 30 tons of oil, this average of 6·8 tons seems low, and it may be presumed that a considerable proportion of the 44 were of small size. In the table on p. 131 (vol. ii.), referring to the four years ending with 1817, the largest annual average number of whales per ship is 12·2, obtained by 33 vessels from Peterhead; and these 402 whales produced only 3,815 tons of oil (average 9·5 tons=57 barrels per whale) and 187 tons of whalebone. It is important to realise that the reduction of the number of Greenland whales to a point near extinction was the result of operations not comparable in their magnitude with those now being carried on in the Antarctic fields.

According to Eschricht and Reinhardt¶ the Dutch caught 6,986 whales from 1719 to 1778 (60 years), in Davis Strait and Disco Bay, but this gives an average of only about 116 whales a year. A much larger number were taken by British ships, in the most northerly parts of Baffin's Bay, and in Lancaster and Barrow Straits, in the four years 1827-1830, when 3,391 whales

* Scoresby, 1820, ii. p. 53.

† *Ibid.* p. 55.

‡ *Ibid.* p. 119.

§ *Ibid.* p. 123.

|| *Op. cit.* i. p. 462.

¶ Eschricht and Reinhardt, 1866, p. 13.

were captured, an average of 848 a year. "The persecution was carried on with great success and very extensively, until the profits, some twenty years ago [ca. 1841], began to diminish, and the fishing trade gradually to dwindle away, until it reached its present comparatively unimportant state"*. This "violent war of extermination, continued during more than a century," produced the same result in Davis Strait and Baffin's Bay that had already been reached off Spitsbergen. The industry did not, however, become extinct until the early years of the present century. In a Report, dated September 1913, by the Acting Superintendent, Mercantile Marine Office, Board of Trade, Dundee, figures are given for the Port of Dundee for the years 1870 to 1913. In 1874, 190 Greenland Whales were killed by 11 ships, and the produce was 72 tons of whalebone and 1,419.5 tons of oil. The average catch per ship was thus 17.3 whales, and the average produce of each whale was 0.38 tons of whalebone and 7.47 tons of oil = 44.82 barrels. The number of ships increased to 17 in 1885, but only 27 whales were caught in that year, although 79 had been taken in 1884 by 16 ships. From 1887 there were not more than 10 ships in any year, and with this number the catch generally averaged less than 2 whales a ship. The largest total after 1887 was 29, obtained in 1893 by 5 ships. In 1910, 18 whales were caught by 10 ships; and in 1911 only 7 by 8 ships. The discouraging results of that year are indicated by the fact that only 1 ship left Dundee in 1912 and 1913, and that the total catch in each of those years is returned as 0.

The Greenland Whale had, however, yet another stronghold, which was invaded by American whalers many years before the cessation of its pursuit on the two sides of Greenland. According to Scammon † Right Whales had been pursued for several years on the coast of Kamchatka and in the Sea of Japan before it was known that "Bowheads" existed in the Arctic Ocean near Bering Strait and in the Sea of Okhotsk. The Bowhead is generally regarded as the Greenland Whale under another name, and it can hardly be more than a local race of that species. In 1848 Captain Roys was the first whaler to pass through Bering Strait to the Arctic Ocean, where he found "whales innumerable, some of which yielded two hundred and eighty barrels of oil." "The Okhotsk Sea at one time equaled (*sic*) if not surpassed the Arctic as a productive whaling-ground"‡. In 1871 34 vessels were lost in the Arctic Ocean §, but in 1877 a number of ships were still at work there and whales were specially numerous||. The number of American vessels constituting the North Pacific fleet during the years 1835 to 1884 is tabulated by Howard Clark ¶. Before 1848 the fleet worked entirely to the south of Bering Strait, but after 1868 most of it repaired to the Arctic Ocean. It reached its largest size (292 ships) in 1846, when 253,800 barrels of oil

* Eschricht and Reinhardt, 1866, p. 14.

† Scammon, C. M., 1874, p. 58. ‡ *Ibid.* p. 60.

§ Clark, A. H., 1887, p. 79. || *Ibid.* p. 76. ¶ *Ibid.* pp. 84, 85.

were obtained. The number of ships declined to 138 in 1851 (86,360 barrels), but rose to 278 in 1852 (373,450 barrels). From that year it fell fairly regularly to 16 in 1875 (21,680 barrels), but it had risen to 39 in 1884 (20,450 barrels). A few foreign vessels are not included in these figures.

Whaling to the north of Bering Strait was continued on a small scale until the present century, but it appears to have become extinct during the last few years.

The pursuit of the Greenland Whale has thus had three successive phases: (1) in the neighbourhood of Spitsbergen, Jan Mayen, and the east coast of Greenland from 1611; (2) Davis Strait, Baffin's Bay, and neighbouring waters from 1719; (3) south and north of Bering Strait and the Okhotsk Sea from 1843*. In each case whales were extraordinarily plentiful when the operations were commenced, subsequently declining in number to a point when whaling ceased to be profitable and was abandoned.

It may be hoped that the Greenland Whale is making some recovery as the result of the cessation of its pursuit, but not much information on the subject is available. There has been no sign of its return to the bays of Spitsbergen, a locality which is frequently visited; and, if any are still to be found on the old whaling grounds, they are at the most an insignificant fraction of the great schools which once frequented them.

3. *Whaling on the Coasts of the United States.*

An account of this industry is given by Howard Clark†. The abundance of whales on the coast is said to have been one of the main arguments for the early settlement of Cape Cod by the English—and the animals were at that time numerous, close inshore, where they were hunted during the 17th century. They are believed to have been principally Humpbacks and Biscay Whales. The history of their pursuit followed the usual course. A record published in 1748 draws attention to the fact that, although whales were formerly to be found “alongshore” near Cape Cod, “After some years they left this ground and passed farther off upon the banks at some distance from the shore”‡. Long Island was in early times the rival of Cape Cod§. By 1718 the value of the whaling industry was stated not to exceed £20 per annum||. According to Allen¶ the Cape Cod whaling declined at the end of the first quarter of the 18th century, and was practically abandoned by 1750.

Shore whaling was revived on the eastern coast of the United States, from Maine to South Carolina, during the 19th century. From 1810 to about 1840 Humpbacks were the chief object of the Maine shore-fishery, but Fin Whales were also caught**. “A great many whales were killed in New England waters during the '70's and '80's, but what proportion of them were Humpback

* Clark, A. H., 1887, p. 74.

† *Ibid.* p. 26.

‡ *Ibid.* p. 27.

§ *Ibid.* p. 32.

|| *Ibid.* p. 40.

¶ Allen, G. M., 1916, pp. 158, 159.

** *Ibid.* p. 313.

Whales cannot now be ascertained"*. After 1895 shore whaling in New England was again abandoned.

The same method of whaling was employed on the coast of California from 1851 †, the species pursued being Humpbacks and Pacific Grey Whales, with an occasional Right Whale or Rorqual. As in other instances, the whales at first frequented the coast, but "having been so long and constantly pursued, are exceedingly wild and difficult to approach"‡. In 1879 there were still six localities where shore-whaling was practised or had lately been carried on§, but seven other localities are mentioned where whaling had been discontinued.

4. *Sperm Whale* (*Physeter catodon*).

This whale normally inhabits the warmer waters of the world; but stragglers, nearly always large males, are caught from time to time, even as far from the Equator as the icy waters of both Poles. They were formerly hunted on a very large scale in the Atlantic, Pacific, and Indian Oceans. Brown Goode states ||: "There is no reason to doubt that Sperm Whales were at one time, nearly two centuries back, as abundant in the North Atlantic as in more recent years in the North Pacific. The vigorous prosecution of the whale fishery since the early part of the eighteenth century by American vessels has had much to do with their present scarcity."

I have taken most of my facts referring to the history of American whaling from Howard Clark's account ¶. Sperm whaling appears to have been commenced on the New England coast about 1712, and by 1770 the fleet had grown to 125 vessels, the localities visited being various parts of the Atlantic, including Brazil, the West Indies, the Banks of Newfoundland, and the Cape Verde Islands. A few years later the voyages were extended beyond the Equator to the Falkland Islands. In 1790 France had about 40 ships engaged in Sperm whaling, but French activities in this direction came to an end with the Revolution. English ships had joined in the business in 1785, and in 1788-1790 the 'Amelia' of London was the first ship to sail round Cape Horn into the Pacific, where "the enormous cargo of 139 tons of sperm oil" was obtained **. In 1789 the operations were extended to the Indian Ocean, the neighbourhood of Madagascar proving to be a rich whaling ground.

Pacific whaling rapidly increased, the coasts of Chili and Peru and the Galapagos Islands becoming favourite resorts. About 1802 the Sperm Whale began to be hunted in New Zealand waters ††, and vessels were visiting the Molucca Islands with the same object. New grounds were shortly afterwards discovered in the Japan seas, where there were nearly 100 whaling-ships in 1835. An English ship found "immense numbers of the

* Allen, G. M., 1916, p. 314.

† Jordan, D. S., 1887, p. 52.

‡ *Ibid.* p. 53.

§ *Ibid.* p. 54.

|| Goode, G. B., 1884, p. 8.

¶ Clark, A. H., 1887, p. 63.

** *Ibid.* p. 67.

†† *Ibid.* p. 69.

spermaceti whale" off the coast of Japan in 1820*. The Indian Ocean was being extensively explored at this time, and the 'Swan,' an English ship, saw "immense numbers" of Sperm Whales in the neighbourhood of the Seychelles in a voyage which lasted from 1823 to 1825†.

In 1837 the highest point of the industry was reached, and "The extraordinary success of the fleet of whalers led to a rapid increase in the number of vessels"‡. In 1842 there were 594 ships from the United States and 230 from other nations, a total of 824. The American fleet reached its highest numbers in 1846, when it consisted of 729 ships; but it is not possible to state accurately how many of these were hunting Sperm Whales (see Southern Right Whale, p. 65). The general history of the operations from 1837 to 1875 may be inferred from the following table, which has been constructed from the figures given by Howard Clark §:—

AMERICAN WHALING FLEET.

	Whaling generally.	Sperm whaling.	Sperm oil pro- duction (gallons).
1837	—	—	5,329,138
1842	594	—	—
1844	617	315	—
1846	729	—	—
1860	560	—	2,306,934
1870	316	231	1,738,265
1875	163	134	1,342,435

The United States fleet began to decline after 1846, and Howard Clark continues:—"The general decline of the whale-fishery, resulting partly from the scarcity of whales, had led to the abandonment of many of the once famous grounds, and cargoes of sperm oil are obtained only after the most energetic efforts in scouring the oceans. In the Western Pacific Ocean, the Indian Ocean, and the Japan Sea, where once large fleets of vessels cruised, there are now but few"¶. In 1877 there were, however, good catches in the North Atlantic, off Chili and New Zealand and in the Sulu Sea. In 1880 the Indian Ocean and Sulu Sea Sperm grounds were abandoned by the American fleet. The sperm oil obtained by American vessels in that year amounted to 1,184,841 gallons**, the smallest quantity, with the exception of the years 1865 and 1874, since 1826.

The following figures (gallons of sperm oil) give the total production of American ships during 70 years††:—

1810-20	5,159,495
1820-30	22,848,336
1830-40	41,241,310
1840-50	39,146,055
1850-60	26,260,806
1860-70	16,305,377
1870-80	12,819,493

* Clark, A. H., 1887, p. 69. † *Ibid.* p. 70. ‡ *Ibid.* p. 71.

§ *Ibid.* pp. 70, 71. || *Ibid.* p. 145. ¶ *Ibid.* p. 71.

** According to Scoresby, 1820, ii. p. 408, a ton of whale oil is equivalent to 252 gallons, and the amount in question is thus 28,210½ barrels, at 6 barrels to the ton.

†† Clark, A. H., 1887, p. 72.

In 1881-1883, as shown by the Trade Returns given on pp. 164-165 of Howard Clark's account, the industry continued to decline, although in 1884 rather better results were obtained by the North Atlantic fleet. The American whaling had, however, almost ceased to exist. It had considerably passed its maximum at a time when whale oil and sperm oil were still without a rival as illuminants. But in 1859 a successful operation in Pennsylvania was the commencement of the great petroleum industry in America, and the competition of this new source of light lowered the price of sperm oil. This contributed to the difficulty of making profits from whaling expeditions*, and was certainly an important factor in the extinction of the old method of Sperm whaling, which took place after 1884. Although this may be admitted, Sperm whaling had reached its zenith in 1837, more than 20 years before it had petroleum as its competitor. The decline from that year, to 1860 at least, must be attributed to a destruction of whales in excess of their rate of reproduction.

The Sperm Whale is not, indeed, one of the species about which immediate anxiety need be felt. There is no evidence that it occurs in any ocean in the "immense numbers" formerly reported, but modern whaling has included it in its operations in many localities, and in some of these it is still fairly plentiful (see p. 88).

5. *Southern Right Whale* (*Balæna australis*).

The history of the whaling founded on this species is closely connected with that of Sperm whaling. When adventurers began to explore the southern oceans in search of the Sperm Whale they became acquainted with the Southern Right Whale, and both species were caught by the same vessels. Several species of Southern Right Whale have been described, but it seems probable that they should all be referred to a single species, which is closely allied to, though probably distinct from, the Biscay Whale. It is known to have frequented the coasts of South Africa, Australia, New Zealand, Kerguelen, and other southern localities. Like other Right Whales this species was formerly found on the coasts. Table Bay was formerly one of its favourite resorts, and Bennett †, in 1832, "noticed fragments of these monsters strewn profusely on the beach at Cape Town." He adds: "It is to be regretted that this method of fishing from the shore involves almost solely the destruction of females and their calves," and states that latterly their visits to Cape Town have become rare, so that whalers have to pursue their occupation in other bays on the same coast. According to Guldberg‡, the whaling grounds of the Southern Hemisphere 150 years ago swarmed with Southern Right Whales ("Vor 150 Jahren wimmelten die Walgründe der südlichen Hemisphäre von Südwalen"), and the American whalers caught

* Jenkins, J. T., 1921, p. 234.

† Bennett, F. D., 1840, ii. p. 230.

‡ Guldberg, G., 1903, p. 814.

"thousands and thousands of these great animals." 193,522 Right Whales were captured from 1804 to 1817, and, if this is correct, it gives an average of 13,823 annually—an amount comparable with the results of modern whaling. The Southern Right Whale appears to range from about 15° S. to nearly 60° S., with its principal distribution between 30° and 50° S. According to Bolau* it was to be found in swarms in the southern parts of the Indian Ocean from 1820 to 1839, when great fleets of whalers pursued it off the Crozet Islands, St. Paul and Amsterdam Islands, Kerguelen, Australia and Tasmania, or in the open sea. During a voyage, 1837-1839, from the Cape of Good Hope to Tasmania, hardly 24 hours elapsed without passing a vessel occupied with the flensing of a whale [although some of these may have been Sperm Whales]. Whaling was still proceeding in 1853 at St. Paul and Amsterdam Islands, where this species was so common, from May to October, that "what could be said of its abundance would hardly appear credible." Now these "once so rich fishing grounds are abandoned, the giants of the sea are mostly killed by the war of destruction which man's greed has waged against them without pity." In the time of Sir James Clark Ross (1840) whales were common at Kerguelen, and evidence of their former abundance there was obtained by the 'Gazelle' in 1874-76 from the numerous bones of whales, believed to be those of Right Whales, which had been left by the old whalers on the shore. It is not certain, however, that the whales observed by Ross really belonged to this species.

In the Pacific, many Southern Right Whales were captured off the coast of Chili "40 years ago"†. The bays of New Zealand, like those of Cape Town, were visited by the females of this species, which brought forth their young in them. There were good whaling grounds 150-200 km. from the Auckland Islands, and off Stewart Island, New Zealand, and the South and West coasts of Australia. "Most of the whaling grounds of the Southern Pacific are now so unproductive that a regular catching industry is no longer carried on. It will be long before these grounds are repopulated with whales if this indeed ever happens"‡.

Southern Right Whales continue to figure in the catches, during recent years, of modern whaling stations; but the number is insignificant compared with the catches of earlier years.

6. *North Pacific Right Whale* (*Balæna sieboldii*).

This whale has a distribution between about 30° N. and 55° N. in the Pacific, corresponding with that of the Biscay Whale in the Atlantic—its northern limit practically coinciding with the southern limit of the Greenland Whale. It is uncertain whether it should be regarded as a distinct species. Some authorities consider it a form of *B. australis*, although it is separated by the

* Bolau, H., 1892, pp. 417, 418.

† Bolau, H., 1895, p. 13.

‡ Bolau, H., *loc. cit.*

width of the tropics from the Southern Right Whale. Its breeding places appear to be unknown.

Scammon*, who figures the animal (pl. xii.), states that in former years *B. sieboldii* was found on the coast of Oregon, occasionally in large numbers, but chiefly on the "Kodiak Ground," extending from Vancouver Island to the Aleutian Islands; a few stragglers occurring as far south as California. On the opposite side of the Pacific it occurred off Kamchatka, and these whales congregated in large numbers in the Okhotsk Sea. At certain times they could be seen in pairs or triplets, "scattered over the surface of the water as far as the eye can discern from the mast-head." Considerable numbers were taken by American whalers, specially at about the middle of the nineteenth century. According to Bolau†, 300-400 whaling ships engaged in the pursuit of this animal were to be found on the Kodiak Ground from April to September in 1846-1851. "By ardent pursuit, especially by the use of bomb-harpoons, the animals have been nearly exterminated on the north-west coast" [of America]. The Japanese appear to have formerly hunted this Right Whale, in their own waters, from an early period, but it seems to have become rare in the North Pacific, and it is not mentioned in recent returns from that area.

7. *Pacific Grey Whale* (*Rhachianectes glaucus*).

This species resembles the Right Whales in the absence of a dorsal fin, but it is distinguished from them by its small head, its short baleen, and other characters. According to Scammon‡, it formerly frequented the coast of California, from November to May, but did not extend its range southwards beyond 20° N. The females entered the lagoons of the coast in large numbers to bring forth their young; the males generally remaining outside. At the end of the season males, females, and young worked their way northwards, keeping so near the shore that they often passed through the kelp, and being seldom observed far out at sea. In summer they congregated in the Arctic Ocean and the Okhotsk Sea, where they might be seen emerging between the floes or forcing their way through the ice. It was estimated that about 1,000 passed southwards daily from December 15 to February 1 for several successive seasons, after shore whaling was first established in 1851; and this was considered a low estimate§. At the "present time" [1874] the average number passing would not exceed 40, but Scammon believed that there were others travelling out of sight of land and that the daily number during this period was probably 100-200. The whole number captured from the commencement of bay whaling (given by Scammon, p. 23 n, as 1846), presumably to the date of Scammon's work, would not

* Scammon, C. M., 1874, pp. 66-69.

† Bolau, H., 1895, p. 11.

‡ Scammon, C. M., 1874, p. 22.

§ *Ibid.* p. 23 n.

exceed 10,800. This gives an annual average of 372. At the mouth of a lagoon Scammon observed many of these whales in water barely deep enough to float them, and even playing in the breakers. They have been seen, on returning to the surface after a dive, with their head and lips besmeared with dark ooze from the bottom. They collected at the ends of the lagoons during the breeding season in such numbers that it was difficult for a boat to cross without touching them. They frequently grounded in but two or three feet of water, until the rising tide floated them off, uninjured—and a female might be thus situated, with her calf playing in the water round her. This habit of getting into shallow water, where swimming was impeded, gave the pursuers a decided advantage.

After a time the whalers used to resort to places along the coast where the kelp was thickest, and there wait for their prey; but during a few successful seasons the whales learned by experience and took a route further from the shore. The whalers sometimes used the regrettable practice of harpooning the calf and hauling it to land, followed into shallow water by the mother, which could be shot from the beach.

On reaching the neighbourhood of Vancouver Island, during their northward migration, the whales were attacked, in canoes, by Indians, whose native weapons were harpoons, the detachable end of which was connected by a rope with a buoy made of seal-skin. They were not safe even in their Arctic quarters, where they were hunted by the Esquimaux in a similar manner. Scammon ends his account as follows*:—"None of the species are so constantly and variously pursued as the one we have endeavoured to describe; and the large bays and lagoons, where these animals once congregated, brought forth and nurtured their young, are already nearly deserted . . . ere long it may be questioned whether this mammal will not be numbered among the extinct species of the Pacific."

Scammon's prophecy came very near fulfilment, as shown by the later history, for which reference may be made to Andrews† and to Risting‡. Shortly after the publication of Scammon's book, the industry "began to decline, and for several years was conducted only in a desultory manner by a number of Portuguese upon the shores of Lower California. During the past twenty years the species had been lost to science and many naturalists believed it to be extinct"§.

In the winter of 1911-12, Andrews spent January and February at a whaling station on the south-eastern coast of Korea, and there confirmed his conclusion (which had previously been reached by Möbius||) that *Rhachianectes* was being hunted by the Japanese. Fifty or more of this species were taken during his visit. He was

* Scammon, 1874, p. 33.

† Andrews, R. C., 1914; 1916 *b*, p. 186.

‡ Risting, S., 1928, p. 80.

§ Andrews, 1914, p. 232.

|| See Bolau, H., 1895, p. 15.

able to verify Scammon's statements as to the preference of this animal for shallow water, remarking that the Korean whales frequently escaped by swimming into water so shallow that the ships could not follow them *. It is obvious from this account that the species existed in some numbers at the time of his visit, but there can be no question of the fact that its numbers were formerly reduced almost to the vanishing point on the coast of California, in the neighbourhood of which a few specimens have reappeared during more recent years (see p. 82, under Mexico; see also p. 83, under Japan and Korea).

8. *Humpback* (*Megaptera nodosa*) †.

The early history of this species is uncertain, but there is good reason to believe that it was one of the whales formerly captured by the shore-whalers on the New England coast (see p. 61). It has probably been hunted from an early date by the Japanese, who esteem it as an article of diet.

The Humpback has a very wide distribution, in both Northern and Southern Hemispheres. Unlike the Right Whales, it extends its breeding migrations well into the Tropics, even as far as the Equator. It has often been the first whale hunted when a new field has been opened, and it has generally disappeared soon after the commencement of the operations. This has been ascribed to the timidity or intelligence of the animal, which is supposed to be more easily frightened away from a whaling field than other whales; but there can be no reasonable doubt that excessive destruction has been at least partially responsible. Further information on this subject is given below, in considering the results of modern whaling in the Antarctic regions and elsewhere.

9. *White Whale* (*Delphinapterus leucas*).

This is a member of the Odontoceti or Toothed Whales, and is placed in the same Family as the Narwhal. Although relatively unimportant from a whaler's point of view, it may be referred to briefly as another illustration of the usual course of events. Its skin can be made into valuable "Porpoise leather," and for a long series of years ships sailed from Tromsø to hunt it off Spitsbergen. According to Collitt ‡, the schools now found there during the summer months are inconsiderable compared with those of the seventies of the last century. The Tromsø vessels were formerly able to kill about 2,000 White Whales annually, but since the 'nineties they have seldom caught more than 300, and in certain years less than 20. Collitt adds: The capture of White Whales

* Andrews, 1914, p. 238.

† As in the case of the Rorquals, I assume provisionally that the specific difference of the northern and southern races has not been satisfactorily established.

‡ Collitt, R., 1912, p. 665.

at Spitsbergen may be said to be almost discontinued. Year by year they go further to the East to find an unmolested place for breeding.

10. *Modern Whaling.*

This is based mainly on Rorquals, the species of practical importance being:—

Blue Whale or Sibbald's Rorqual (*Balænoptera musculus*).

Fin Whale or Finback (*Balænoptera physalus*).

Sei Whale or Rudolphi's Rorqual (*Balænoptera borealis*).

Bryde's Whale (*Balænoptera brydei*).

The Humpback has most often been important in the initial stages of the operations.

The systematic hunting of Rorquals, on a large scale, commenced after the middle of the nineteenth century. This was due to several causes. The whalebone of the Right Whales, particularly that of the Greenland Whale, had at one time commanded an extremely high price (see p. 57), owing to the great length and superior quality of their whalebone-blades. Sperm oil, which differs essentially from the train-oil or whale-oil of the Whalebone Whales, had been greatly in request before the introduction of the heavy mineral oils. The carcasses of the Right Whales and of the Sperm Whale generally float at the surface, whereas those of the Rorquals sink; and this was a great advantage in the old days, when operations were conducted with small ships and the whales were killed by still smaller boats. The Rorquals produce inferior whalebone, and they were regarded, moreover, as too swift and dangerous to be molested with impunity.

The introduction of Svend Foyn's harpoon-gun, in 1865, revolutionised whaling, and the invention was made at a time when Right Whales and Sperm Whales were becoming difficult to obtain. The use of small boats was discontinued, and Rorquals could now be shot from the bow of the ship, the heavy harpoon carrying a rope large enough to be used for raising the carcass to the surface, where it could be artificially inflated with air and towed to a land station.

Mr. J. A. Mörch makes some significant remarks on the results of the new method, in a paper* written with the object of drawing attention to the rapidly developing Antarctic industry. He states that when Svend Foyn had perfected the harpoon-gun in the latter part of the 'sixties, and had commenced operations in the Varanger Fjord on the Finmark† coast of Norway, Blue Whales were the only object of his pursuit. With the entry of new companies, Fin Whales, Humpbacks, and Sei Whales were also caught. "Successively, however, the Blue Whales became scarcer and scarcer, and the other species of Whales, especially

* Mörch, J. A., 1911, p. 665.

† See also Risting, S., 1922, p. 107.

the Finbacks, came to play the principal part in the catches. The same order of things has, as a rule, repeated itself also in most other whaling-grounds in the North Atlantic" (p. 665). After referring to Newfoundland, where "the stock of Whales has in the course of only a very limited number of years been seriously reduced" (p. 668), he mentions the Murman coast, where two whaling stations were started by the Russians, and he continues: "After a few seasons of successful hunting, however, the Whales became scarcer and scarcer, so that at last their pursuit had to be given up" (p. 669).

The new methods were introduced at a time when whaling seemed to be moribund. The older whaling fields had been successively worked out and were mostly deserted, but the possibility of capturing Rorquals gave new life to the industry, which was carried on for the next forty years in various localities, including, in addition to those just mentioned, Spitsbergen, Iceland, the Færoe Islands, the Shetland Islands, Harris (Outer Hebrides), the West coast of Ireland, Labrador, British Columbia, Japan, and Korea. Whales are still pursued in the Northern Hemisphere, but the amount of whaling there has been largely influenced by the recent opening of the great fields of the far south. This event again saved the industry from collapse, which would almost certainly have occurred before long; and in support of this statement I quote some observations by Mr. S. Risting*, the Secretary of the Norwegian Whalers' Association. He refers to a law which had recently made whaling illegal on the Norwegian coasts. The fishing industry had for some years advocated the view that whaling operations were inimical to their interests†. Risting states that the years 1904-1906 were hard ones for Norwegian whalers, in consequence of this prohibition, and that it was becoming difficult for them to know where to go in pursuit of their quarry. Spitsbergen had been a disappointment, and there were indications of a decline in the Færoes. The other suitable grounds in the North Sea were all occupied. The stock of whales seemed to be already affected by the hunting operations and it was difficult to find places for the unoccupied ships of the fleet. "The capture of whales was in fact everywhere an ailing business, which in the course of a short series of years seemed likely to come to an end" (p. 305). It was thus necessary to think of new and more distant whaling fields. The reports of Weddell and other navigators had revealed the richness of the Antarctic seas in seals and whales, and the attention of Norwegian whalers became specially fixed on this part of the world.

A whaling expedition from Dundee had visited Antarctic waters in 1892-93, but it was equipped merely for the capture of Right Whales, which were not found. In 1894-95 H. J. Bull of Tønsberg had commanded an expedition to South Victoria Land, with a similar object, but with the same want of success

* Risting, S., 1922, p. 303.

† See also Hjort, J., 1902, pp. 196 *et seq.*

so far as Right Whales and Sperm Whales were concerned. He came to the conclusion, however, that an expedition fitted for the capture of Rorquals by modern methods would produce profitable results. In 1901 the Swedish Antarctic Expedition left Göteborg for the far south, under the command of the well-known whaling Captain C. A. Larsen*, who had visited the South Shetlands in the 'Jason,' in 1893-94, in search of Right Whales and Seals. He was doubtless acquainted with Capt. Bull's conclusion, but in any case his own personal experience convinced him of the suitability of these waters for modern whaling. On his return to Buenos Aires he founded the *Compania Argentina de Pesca*, the first of the modern Companies to operate in Sub-Antarctic waters. On returning to Norway in 1904, Larsen reported that in the region of the South Shetlands, the South Orkneys, South Georgia and the South Sandwich group there occurred "masses" of whales belonging to the common northern species.

The region in question lies between 55° S. and 62° S., but although not within the Antarctic Circle it is to be considered completely polar. The coast of South Georgia is free from ice, however, during the whole year. Risting states (pp. 314-315) that the so-called Cape Horn Current, with its cold water from the Pacific to the Atlantic, passes the coasts of the South Shetlands, where there are numerous Fin Whales which feed on a small herring ("sild"), 6-7 cm. long, which occurs there in enormous numbers. This does not agree with the results of the 'Discovery' expedition, which show that the Whalebone Whales, including the Fin Whale, feed almost exclusively on a Crustacean (*Euphausia superba*) when they are in the neighbourhood of South Georgia. Larsen observed thousands of Humpbacks off that island, and numerous Blue Whales, specially along the ice-edge further south. There were here enormous quantities of "Krill," the small Crustacea on which the Blue Whales were feeding. He also saw a single Right Whale. He decided that South Georgia was the best place for the first whaling station, which he named Grytvik. He anticipated that the best catches there would be made in the southern winter, but that the Blue Whales could be sought along the ice-edge during the summer. The whaling season in this district would thus be a long one, although it would not be carried out entirely in one place. Larsen's first whaling boat was the 'Fortuna,' 100 feet long and 20 feet in beam, and thus considerably larger than the vessels used in the north. He returned to South Georgia in the autumn of 1904, and this was the commencement of modern Antarctic whaling.

The next whaling venture was undertaken by Chili, with a Norwegian Captain, A. A. Andresen, who went south in 1905, having chosen a land station in the Straits of Magellan, near

* Risting, S., 1922, p. 313.

Punta Arenas. Whaling in the confined Straits did not prove very successful, and it was found better to conduct operations in the open sea. Floating factories, or large vessels on which the oil could be "tried out," were thought the most promising line of development. They had first been used with success off Spitsbergen*, during the modern period.

An expedition organised by Chr. Christensen † and commanded by A. Lange arrived at the Falkland Islands on Dec. 13, 1905, with the floating factory 'Admiralen,' accompanied by two whale-catchers, the smaller ships which pursue and kill the whales. This expedition commenced work in these islands, where there were at first many Fin Whales, but more Sei Whales. In January 1906 the whales were found to be travelling further and further from the land, and on Jan. 24 the expedition accordingly left for the South Shetlands, which they reached on Jan. 27. The weather was unfavourable, with fog and storm; and the difficulties were accentuated by the fact that the adventurers were in uncharted seas. Numerous Fin Whales and large Blue Whales were seen, and the catch consisted mainly of Blue Whales and Humpbacks. The expedition returned to the Falkland Islands on Feb. 28, and operations were re-commenced there and carried on until Apr. 11. The total catch of the voyage was 183; 24 Blue Whales, 36 Fin Whales, 23 Humpbacks, 97 Sei Whales, and 3 Sperm Whales. This was the commencement of whaling at the South Shetlands.

The first Norwegian Company to operate at South Georgia was the Sandefjord Company ‡, which commenced work in 1906, but the results were unfortunate, as its floating factory sank. In 1906 Christensen's Company, the Ørnen, definitely gave up Spitsbergen§, where it had previously operated, and returned to the South Shetlands. Whaling was begun at the Falkland Islands in October and was resumed on the return passage in March 1907. The total catch was 336 whales, of which 90 were caught off the Falkland Islands. The Chilean Company commenced operations in 1906-7 in the Straits of Magellan, then proceeding to the South Shetlands and afterwards returning to the Straits, where it captured 73 Right Whales.

I have described the early history of Antarctic whaling, taking the facts from Risting (1922), because the commencement of an enormous industry is an event of some interest and the facts are not generally known in this country. For further information the Report of the Interdepartmental Committee (1920) may be consulted with advantage.

The new Antarctic industry was a success from the first, and it developed with great rapidity. New Companies were founded and conducted their operations principally at South

* Risting, S., 1922, pp. 245, 319.

† *Ibid.* p. 327.

‡ *Ibid.* p. 319.

§ *Ibid.* p. 329.

Georgia and the South Shetlands. The size of the whale-catchers was increased and the whaling plant was made more efficient. In 1910-11 the total number of whales captured at South Georgia alone reached the high figure of 6,529, of which 6,197 were Humpbacks*.

South Georgia, the South Shetlands, and the South Orkneys are at present the principal localities, in that sector of the Antarctic, where whaling is carried on. They are Dependencies of the Falkland Islands and therefore under the control of the British Government, which took early steps for regulating the industry. At South Georgia the operations of cutting up the whales and preparing their oil, "guano," and bone-meal are conducted at land factories. The South Shetlands offer practically no facilities for the erection of permanent buildings, and the work is done on floating factories, to which the whales are towed by the whale-catchers. The Companies operate under licences from the Government, the number of catchers being definitely restricted in each instance. There are, moreover, provisions for utilising as much as possible of the carcasses (the entire carcass in the case of the shore-stations), and for avoiding the capture of females accompanied by calves. Each Company is required to send to the British Museum (Natural History) a detailed return of every whale killed, including the date of capture, the species, the sex, the total length, and the length of the foetus in the case of pregnant females. These returns form a valuable mass of evidence with regard to the southern whales, and they would be even more valuable if it were not for the suspicion that some of them had been deliberately falsified in certain respects. The other principal sources of information are the monthly numbers of the Norwegian Whaling Journal (the '*Norsk Hvalfangst-Tidende*'), of which I have made extensive use, Risting's two Memoirs (1922, 1928), and the Report of the Interdepartmental Committee (1920). No accurate statistics are available before the season 1909-10.

The rapidity of the growth of the southern industry is indicated by the following figures†, which have been selected from a series extending from 1906 to 1917. An approximate estimate of the amount belonging to the Antarctic whaling can be made by comparison with the figures given on pp. 76, 77.

NUMBER OF BARRELS OF WHALE-OIL.

	World's Catch.	Norwegian Companies.
1906.....	75,000	51,000
1910.....	320,000	187,800
1911.....	625,000	360,000
1913.....	800,000	630,000

Six barrels of oil are equivalent to 1 ton, or to 252 gallons.

* Risting, S., 1922, p. 373.

† Rep. Interdep. Comm. 1920 p. 68

The first year given in the table is some 12 months after the commencement of Antarctic whaling, and its oil-production is less than one-tenth of that of 1913, seven years later. The industry has continued to grow since then, and the season 1925-26 produced over a million barrels of oil, the largest total recorded to that date.

It is important to obtain a clear idea of the proportion of the world's whaling which is carried on in Antarctic localities. For this purpose I have constructed the table on p. 76, 77, showing the world's production, so far as it can be ascertained, of a single recent year. The Antarctic season generally commences in October (the southern spring) and terminates in April or May, and it thus involves parts of two Calendar years. In lower latitudes the season falls within a single Calendar year; but, although the figures do not completely coincide in point of months, each refers to a single period of 12 months. The table is constructed primarily on the basis of a record in the 'Norsk Hvalfangst-Tidende' of the whaling industry of the world, including the oil-production for 1925-26, but not the numbers of whales. With regard to the number of vessels employed it may be summarised as follows:—

	Land Stations.	Floating factories.	Whale- catchers.	Barrels of oil.
Norwegian Companies	17	19	110	655,608
Other Companies	20	6	110	526,283
Total	37	25	220	1,181,891

It shows, in the first instance, that more than half the world's whaling is carried out by Norwegian Companies; but the personnel of many of the other Companies consists largely of Norwegians, who thus have a preponderating influence on the course of the industry generally.

As it is very desirable to know what these figures represent in terms of whales, I have added to the table on pp. 76, 77, the number of whales which corresponds with each of the oil-totals. These have been obtained principally from the "Fangststatistik" published in numbers of the Norwegian Whaling Journal during 1926-1928, but partly from the whalers' returns in the British Museum. In some cases I have been unable to ascertain the number of whales and I have accordingly estimated it from the oil-production. The estimate has been based, where possible, on the results of the Company in question for another year in which the oil-production and the number of whales, for the same season, are both available; but in some cases it has been made with reference to the kinds of whales known to occur in that particular locality, and to other considerations. The final result, with regard to the importance of the Antarctic whaling, is as follows:—

SEASON 1925-26 (OR 1926).

	Barrels of oil.	Number of whales.	Average oil-production of whales.
Antarctic	779,167	13,997	55.7
Other localities...	402,724	12,965	31.1
Total...	1,181,891	26,962	43.8

It thus appears that, in the year in question (with the largest oil-production recorded to that date *) more than half the whales were killed in the Antarctic area, but that this half produced nearly two-thirds of the entire amount of oil. The apparent discrepancy is easily explained by the fact that the Antarctic catch consists preponderatingly of the Blue Whale and the Fin Whale, the two largest species—a fact which is reflected in the oil-averages.

The total number of whales is not shown, however, by these figures. There is no question that a large number of animals are killed by the harpoon, but are not recovered, and do not therefore figure in the catches recorded. Guldberg† has estimated that this loss may amount to as much as 10-20 per cent. of the nominal total; and an estimate of 30,000 whales killed in this single season is probably not too high. This figure is very large compared with what was recorded as the successful annual catch, by British ships, of 848 Greenland Whales in 1827-1830 (see pp. 59, 60). It is considerably in excess of the capture of 193,522 Southern Right Whales said to have been obtained in 1804-1817, an average of 13,823 a year (see p. 65).

A new development of the whaling industry has taken place quite recently, and it was inaugurated by Capt. C. A. Larsen, who had already initiated the whole of the Antarctic whaling. This is, in fact, a reversion to the old system of whaling on the high seas, but it is carried out on a very different scale. The parent ship is a vessel of many thousand tons and is fitted with a flensing stage on to which whales can be hauled through an aperture in the stern or bow. The old pelagic whalers cut up their captures moored to the side of the ship.

Larsen commenced his new operations in the Ross Sea‡ on Dec. 28, 1923, with the 'Sir James Clark Ross,' accompanied by 5 whale-catchers; and he obtained a cargo of 17,500 barrels. In his second season 31,850 barrels were procured, and in 1925-26 39,630 barrels§. A new floating factory, the 'C. A. Larsen,' was added by the Rosshavet Company in 1926-27 to carry on this kind of whaling. The fleet of pelagic whalers has further

* It appears probable that it will be exceeded by the total for 1927-28: see N.H.T. 1928, pp. 89-90.

† Guldberg, G., 1903, p. 809.

‡ N.H.T. 1927, p. 193.

§ These figures are taken from N.H.T. 1928, p. 98; but there are slight discrepancies in the figures recorded elsewhere in the Norwegian journal.

been augmented by the addition of the 'Lancing' (Globus Company) and of the 'N. T. Nielsen-Alonso' (Polaris Company). Other vessels of the same type are projected in England, Germany, and probably elsewhere. The Antarctic figures indicated on p. 75 include 56,630 barrels of oil obtained by the 'Sir James Clark Ross' and the 'Lancing'; but the catches of the pelagic whalers are increasing. The 'C. A. Larsen' is reported to have obtained 76,000 barrels in the 1927-28 season, which she finished by running aground in the entrance to the harbour in Stewart Island. The 'N. T. Nielsen-Alonso' procured 58,000 barrels, the 'Sir James Clark Ross' 50,095 barrels, and the 'Lancing' 47,200 barrels*. This gives a total of 231,295 barrels as the result of the operations of four pelagic whaling ships in a single season.

WORLD-PRODUCTION, 1925-26 (SOUTHERN SEAS) AND 1926†.

	Barrels of oil.	Number of whales.	Barrels of oil, average per whale.
A. Antarctic Area.			
1. South Shetlands.			
Norwegian Companies	208,890 }	4,746	62.0
Other Companies	85,450 }		
2. South Georgia.			
Norwegian Companies	188,491 }	7,819	51.3
Other Companies	212,656 }		
3. South Orkneys	27,050	623	43.4
4. Ross Sea ('Sir J. C. Ross')...	39,630	566 (est.)	70.0
5. South Sea ('Lancing')	17,000	243 (est.)	70.0
B. Africa.			
1. Cape Colony	60,892	2,238	27.2
2. Natal	46,084	1,238	37.2
3. Walvisch Bay	13,200	375	35.2
4. French Congo	12,294	402	30.1
5. Other African localities	ca. 6,000	286 (est.)	21.0
C. Australia and New Zealand.			
Australia	ca. 22,000	550 (est.)	40.0
New Zealand	No record		
D. South Pacific.			
1. Chili	15,250	429	35.5
2. Peru	19,500	542 (est.)	36.0
3. Ecuador	9,000	371	24.3
E. North Pacific.			
1. Mexico, Mexico Co.	14,326	422	33.9
" " Vega" Co.	14,861	394	37.7
2. California	4,860	136	35.7
3. British Columbia	12,900	269	48.0
4. Alaska	25,200	583	43.2
5. Kamchatka	11,586	283	40.9
6. Japan and Korea	25,000	1,281	19.5

* N.H.T. 1928, p. 98-99.

† For the oil-production, see N.H.T., 1927, pp. 26-29, 61-63.

WORLD-PRODUCTION, 1925-26 (SOUTHERN SEAS) AND 1926 (*continued*).

	Barrels of oil.	Number of whales.	Barrels of oil, average per whale.
F. North Atlantic.			
1. Grenada, W. Indies	2,500	72	34·7
2. Newfoundland	11,600	290 (est.)	40·0
3. Spain, Corcubion }	26,938	{ 625 300 }	29·1
" Gibraltar }			
" Soc. Esp. Corona	10,500	350 (est.)	30·0
4. Portugal.....	7,000	278	25·2
5. British, Harris	5,500	212 (est.)	26·0
" Shetland	6,879	269	25·6
6. Færoe Is., Norwegian Co. ...	1,282	42	30·5
" Danish Co.....	3,512	129	27·2
7. Norway, W. Coast.			
Norsk Hvalfangst.....	4,671	206	22·7
Aukra Hval Co.	4,295	185	23·2
Brødr. Sæbjørnsen	1,950	89	21·9
Winge, Blomvaag.....	2,144	94	22·8
8. Spitsbergen	ca. 1,000	25 (est.)	40·0
	1,181,891	26,962	43·8
S. Shetlands, S. Georgia }	779,167	13,997	55·7
S. Orkneys.....			
Ross Sea, South Sea	402,724	12,965	31·1
(' Lancing ')			
All other localities			
	1,181,891	26,962	43·8
Norwegian Companies	655,608		
Other Companies	526,283		
	1,181,891		

11. *Whaling Fields at present worked.*

In this Section I give a summary, based on the figures for 1925-26, with the object of bringing out the relative importance of the several whaling fields, as they are now operated, and of the species of whales which each is catching. The figures do not coincide with those of Risting*, who bases most of his results on the catches of the Norwegian Companies only.

A. Antarctic Area.

(i.) Dependencies of the Falkland Islands (South Shetlands, South Georgia, South Orkneys).

13,188 whales; 722,537 barrels of oil.

Fin Whales, 8,676; Blue Whales, 4,046; Humpbacks, 406; Sperm Whales, 45; Sei Whales, 13; Right Whale, 1; Bottle-nosed Whale, 1†.

* Risting, S., 1928, pp. 8-

† See the table on p. 93 for the details of this catch.

This area by itself accounted for 61·1 per cent. of the oil-production of 1925-26, and 48·5 per cent. of the total number of whales killed. The industry depends for its success entirely on Blue Whales and Fin Whales, with relatively unimportant catches of Humpbacks, Sei Whales, Sperm Whales, and an occasional Right Whale.

The relatively high oil-production is due to the predominance of the Blue and Fin Whales, the two largest kinds. The particular season selected was remarkable for the specially high proportion of Fin Whales at South Georgia and the South Orkneys (see tables on p. 93). Certain seasons are known to be characterised by the predominance of either this species or the Blue Whale, and there is little doubt that this depends on meteorological conditions, particularly on the position of the northern extension of the ice. The Blue Whale frequents the edge of the ice while it remains in polar waters, and in the case of either species there is probably an optimum water-temperature which regulates the position of the principal schools. In some seasons this may correspond more nearly with the latitude of South Georgia and in others with that of the South Shetlands.

In the earlier years during which this field has been worked, Humpbacks (comparatively small animals) were present in enormous profusion, and over 90 per cent. of the catch consisted of this species. The figures for South Georgia (see p. 93) show that more than 6,000 Humpbacks were taken in 1910-11 and about 5,600 in 1911-12. From this point the catch declined with alarming rapidity, both at South Georgia and at the South Shetlands—and it has not recovered. Although this was due partly to the fact that the whalers deliberately turned their attention to the larger and more profitable species, there can be no question that the actual decline was considerable. Even if it be admitted that this resulted from the timidity of the species, leading it to forsake the districts in which it is intensively hunted, I doubt whether this is the whole explanation. In any case the fall was considered so serious that it was thought necessary to prohibit the capture of Humpbacks at South Georgia, though occasional permits to kill them are granted there, from time to time, when other whales are scarce. There is at present no perceptible reduction in the number of Blue Whales and Fin Whales.

(ii.) Ross Sea.

809 whales; 56,630 barrels of oil.

The Ross Sea is at present visited entirely by floating factories engaged in pelagic whaling, the Rosshavet Company having a licence to operate in this district. Detailed statistics are not available, but in 1926-27 the two floating factories ('Sir James Clark Ross' and 'C. A. Larsen') of the Rosshavet Company recorded the capture of 786 whales, consisting of 642 Blue Whales, 82 Humpbacks and 62 Fin Whales*. Blue Whales thus constituted 81·7 per cent. of the catch.

* N.H.T. 1927, p. 158.

With the great increase of pelagic whaling which appears to be imminent it is probable that the importance of this area will rise considerably in the immediate future (see pp. 75, 76).

B. Africa, south of the Equator.

(i.) Cape Colony.

2,238 whales; 60,892 barrels.

The details of the catch for 1926 are not at present available, but the figures given on p. 93 will indicate the nature of the results usually obtained in this locality. The industry is here based mainly on Blue Whales and Fin Whales, the Blue Whales being often the more numerous. The Sei Whale comes next in importance; but, as in other localities in which it occurs, it is capricious in its appearance, certain seasons providing a large number and others very few. Cape Colony is the locality from which Bryde's Whale is most frequently reported, but the numbers of this species are nowhere other than small. A few Sperm Whales and Humpbacks are captured in every season. The Southern Right Whale is rarely caught, although it was once common in the bays near Cape Town (see p. 64).

In spite of the predominance of the two largest species, the oil-aveage is low, and an examination of the details shows that the catch includes a high proportion of immature whales.

(ii.) Natal.

1,238 whales; 46,084 barrels*.

Sperm Whales, 466; Fin Whales, 336; Blue Whales, 214; Humpbacks, 124; Sei Whales, 97; Right Whale, 1.

The composition of the catch (for 1926) differs from those obtained off Cape Colony, in spite of its geographical proximity to that part of Africa, and it shows clearly the influence of the warmer water of the Indian Ocean. Natal is one of the few areas where the Sperm Whale constitutes an important part of the total, and in 1926 it amounted to 37.6 per cent., while in 1925 the actual number caught was 511. The Fin Whale comes next in importance, and in certain years it has been more numerous than the Sperm Whale (see table on p. 93). Blue Whales are fairly numerous, and in 1925 were almost on an equality with Fin Whales, although they are usually caught in smaller numbers. Humpbacks are moderately frequent, and "Sei Whales" less numerous, but it is possible that some of the whales reported under this name may be Bryde's Whales. Right Whales are rarely caught.

(iii.) West Africa.

1,063 whales; 31,494 barrels.

The number of barrels includes those from Walfisch Bay (a) and the French Congo (c), noted below, and 6000 barrels from localities

* N.H.T. 1927, p. 32.

(African) which are not stated. The number of whales is that of the same two localities, with the addition of 286, estimated to correspond with the 6,000 barrels.

A considerable amount of whaling has been done on the African coasts* since the opening of the Antarctic field—on the west from Walfisch Bay, Angola, and up to the French Congo, practically on the Equator. As in other localities, including South Africa, the Humpback was at first the main constituent of the catch†, but the numbers of this species have declined seriously in West African waters as much as elsewhere. The amount of whaling on this coast is at present not very considerable.

(a) Walfisch Bay (22° S.-23° S.).

375 whales; 13,200 barrels‡.

Blue Whales, 226; Humpbacks, 96; Fin Whales, 44; Sperm Whales, 9.

(b) Angola (13° S.-14° S.).

In this locality whaling seems to have terminated for the present, but 430 whales were captured there in 1924 and 288 in 1925, the two seasons showing very different results. In 1924 rather more than half (242) were Sei Whales, the others being 75 Blue Whales, 47 Humpbacks, 32 Bryde's Whales, 17 Fin Whales, and 17 Sperm Whales. In 1925 there were 134 Blue Whales, 51 Sei Whales, 42 Fin Whales, 27 Sperm Whales, 17 Humpbacks, and 17 Bryde's Whales.

It is interesting to note that the Blue Whale, which in polar waters shows a preference for the neighbourhood of ice, seems to be caught more commonly than the Fin Whale off Angola. A Blue Whale was captured by the Company operating in that locality in lat. 1° S., almost on the Equator.

(c) French Congo (just south of the Equator).

402 whales; 12,294 barrels‡.

Humpbacks, 321; Sei Whales, 45; Sperm Whales, 35; Blue Whale, 1.

The Humpback still takes a very decided lead in this locality, being represented by about 80 per cent. of the total. The opinion has been expressed that the "Sei Whales" may have been Bryde's Whales.

C. Australia and New Zealand.

I have not found details of the season in question from these localities. The oil-production of Australia is estimated by the

* See Risting, S., 1922, pp. 470-526, particularly the maps on pp. 478, 486, and 501.

† It was at first 97 per cent. in Natal. ‡ N.H.T. 1927, p. 15.

Norwegian Whaling Journal as about 22,000 barrels. At an average of 40 barrels per whale (probably too high) this would correspond with 550 whales. The Humpback and the Sperm Whale seem to have been the most important constituents of the catch during recent years*.

New Zealand does not appear in the Norwegian table of oil-production, but a few Humpbacks at least are still caught there†.

D. South Pacific.

(i.) Chili (37° S.-40° S.).

429 whales; 15,250 barrels‡.

Fin Whales, 224; Blue Whales, 102; Sperm Whales, 75; Humpbacks, 19; Southern Right Whales, 9.

(ii.) Peru (14° S.).

698 whales; 27,337 barrels (from July 23, 1925, to Apr. 7 1926)§.

Blue Whales, 274; Humpbacks, 242; Fin Whales, 160; Sei Whales, 17; Sperm Whales, 5.

The catch appears to have been made in Paracas Bay (14° S.). This is another instance of the fact, noted on p. 80, that the Blue Whale travels at certain times almost to the Equator||. From the middle of December Blue Whales appeared in large numbers and were travelling south at a considerable distance from land, and many were of large size. This statement seems, however, to refer to observations made during the preceding season. The principal catch of this species in 1925-26 was made from December to the end of March. Humpbacks were most numerous in September and October, Fin Whales from August to November, and the few Sperm Whales were caught during July and August.

It should be noted that the number of barrels from Peru entered in the table on p. 76 is 19,500. The discrepancy is probably due to the fact that the figure given above is that of the catch from July to April 1925-26. The other figure may refer to the Calendar year 1926.

(iii.) Ecuador.

371 whales; 9,249 barrels¶.

Fin Whales, 272; Blue Whales, 68; Humpbacks, 16; Sei Whales, 15.

This locality is practically on the Equator, and its results, for 1926 at least, were very different from those of Peru, rather

* See Risting, S., 1922, pp. 527-557.

† See Lillie, D. G., 1915, for New Zealand Humpbacks.

‡ N.H.T. 1926, p. 189.

§ N.H.T. 1927, p. 77.

|| For a specially large Blue Whale from 9° 30' N., at the Atlantic end of the Panama Canal, see Harmer, S. F., Proc. Zool. Soc. 1923, p. 1085.

¶ N.H.T. 1927, p. 74. The oil-production is given as 9000 barrels in the table reproduced on p. 76.

further south. The Norwegian journal* has some interesting remarks on the constitution of the catch. The proportion of small Fin Whales, 55 feet or less in length, is very high (46·7 per cent.), and that of large individuals of 66 feet or more is very low (9·6 per cent.). Those of medium size, 56-65 feet, form 43·7 per cent. of the total of this species. It is suggested that the first group consists of quite young animals which have recently left their mothers and have associated in larger or smaller schools which spend some time in the warm water of the Tropics. This is said to agree with similar observations which have been made on the Blue Whale, especially on the coast of Angola.

There is reason to believe that the Humpback resorts to warm water, even as far as the Equator, for the purpose of parturition and probably of pairing, but the breeding places of the Blue and Fin Whales are almost unknown. The observations mentioned above are thus of special interest.

It would be specially interesting to know whether the Fin Whales and Blue Whales of Ecuador are northern or southern individuals, or whether they come from both north and south.

E. North Pacific.

(i.) Mexico (Magdalena Bay, Lower California, 24° 30' N.).

816 whales; 29,187 barrels †.

Humpbacks, 498; Blue Whales, 239; Pacific Grey Whales, 42; Bryde's Whales, 34; Sperm Whales, 3.

The record of Bryde's Whale may be regarded as questionable, in the absence of evidence that the determination is correct. The most interesting fact in the return is the appearance of the Pacific Grey Whale (*Rhachianectes*), which had been regarded as extinct, or nearly extinct, some years previously. It is said to reach the southern extent of its migrations in this neighbourhood. The return for 1926-27 does not include Bryde's Whale, but it contains an entry of Sei Whales in about the same proportion as the "Bryde's Whales" of the earlier season.

(ii.) California.

(iii.) British Columbia.

(iv.) Alaska.

} No satisfactory information obtained ‡.

(v.) Kamchatka.

283 whales; 11,586 barrels §.

Fin Whales, 236; Sperm Whales, 35; Blue Whales, 4; Sei Whales, 4; Humpbacks, 4 (and 1 Bottle-nosed Whale, not included in the total).

The very high proportion of Fin Whales is noteworthy, and the small number of Blue Whales is a striking fact. There is no

* N.H.T. 1927, pp. 74-77.

† N.H.T. 1926, pp. 103, 191.

‡ For the totals, whales and oil-production, see N.H.T. 1927, pp. 58, 63.

§ N.H.T. 1927, p. 15.

mention of the North Pacific Right Whale, which formerly occurred in these waters.

(vi.) Japan and Korea*.

1,281 whales; 25,000 barrels.

Sei Whales, 455; Sperm Whales, 364; Fin Whales, 314; Humpbacks, 109; Blue Whales, 28; Pacific Grey Whales, 11.

The Sei Whale appears to be more constant in its appearance off Japan than elsewhere, as is shown by the table of figures from 1919 to 1926 given in the Norwegian journal referred to below. The Sei Whale, the Sperm Whale, and the Fin Whale are throughout the principal constituents of the catch, and they maintain a high level during the whole of the eight years. Humpbacks are distinctly less numerous, and there are comparatively few Blue Whales. The occurrence of the Pacific Grey Whale is, of course, specially interesting, as noted on p. 68. The largest number of this species recorded in the eight years is 78 in 1921, but 114 were taken in 1915 and 105 in 1918. It is the general opinion of Japanese whalers that the industry is declining, and that the fall is most marked in the case of the Grey Whale, of which an annual average of 81 is recorded for the period 1915 to 1919, but of only 21 for 1922 to 1926. The North Pacific Right Whale does not appear in the tables published by Risting and the Norwegian Journal.

F. North Atlantic.

(i.) Grenada, West Indies.

72 whales; 2,500 barrels.

Humpbacks, 71; Bryde's Whale, 1.

This seems to be the only tropical locality, in the Atlantic, at which whaling is being carried on. In the previous season (1925) the catch consisted of 103 Humpbacks and 2 Bryde's Whales. The occurrence of the latter in the West Indies, assuming the correctness of the determination, is of much interest.

(ii.) Newfoundland.

290 whales; 11,600 barrels.

The total number of whales is estimated from the oil-production, at an average of 40 barrels to each whale; but details have not been found.

(iii.) Spain.

(a) Straits of Gibraltar.

300 whales; 8,596 barrels.

Fin Whales, 243; Sperm Whales, 57 †.

This station, which has lately ceased operations, had worked for several years, during which Fin and Sperm Whales appear

* N.H.T. 1927, p. 13; Risting, 1922, pp. 283, 284.

† N.H.T. 1927, p. 64.

to have been the only kinds caught. The result could hardly have been foreseen from what is known of the distribution of the larger Cetacea. The Mediterranean is perhaps deficient in the kind of food which would attract the Sei Whale, for instance. Whales were caught on both sides of the Straits, and a considerable proportion of them, if not all, were passing to or from the Mediterranean.

(b) North Spain.

625 whales; 18,338 barrels *. (The addition of the 8,596 barrels from the Gibraltar station makes a total of 26,934 barrels, which is 4 less than the figure in the table on p. 77.)

Fin Whales, 622; Sperm Whales, 3. The preceding year † had also shown a high predominance of Fin Whales (444), in a total of 483;—the remainder being 30 Sperm Whales, 7 Sei Whales, and 2 Blue Whales. Operations were conducted off Corcubion, close to Cape Finisterre.

(c) Spain, Soc. Españ. Corona.

Details of the results of this Company, mentioned in the oil list ‡, have not been obtained.

(iv.) Portugal.

278 whales; 7,000 barrels §.

Fin Whales, 231; Sperm Whales, 47.

The locality, Setubal, is not far from the Straits of Gibraltar.

(v.) British Islands.

(a) Shetland Islands.

269 whales; 6,879 barrels ||.

Fin Whales, 246; Sei Whales, 16; Blue Whales, 7.

(b) Harris, Outer Hebrides.

5,500 barrels, estimated to correspond with 212 whales, assuming an oil-average of 26·0.

No details have been obtained for 1926, but in 1927 ¶ the total was 184 and consisted of 160 Fin Whales, 12 Sei Whales, 11 Sperm Whales, and 1 Blue Whale.

The period under review does not give a complete record of British Whaling. The Scottish figures for three important species have been published by Prof. D'Arcy Thompson **, with some notes on the Irish catches. Sixty-seven Biscay Whales were killed by the Scottish stations from 1908 to 1914; and, during the same period, 42 Sperm Whales, all, with one possible exception, males; as well as 109 Blue Whales. The great majority of all three species were obtained to the west of Harris. More detailed statistics for Scotland are published, for 1904 to 1914, in an

* N.H.T. 1927, p. 31. † N.H.T. 1926, p. 34. ‡ N.H.T. 1927, p. 63.

§ N.H.T. 1927, p. 74. || N.H.T. 1927, p. 31. ¶ N.H.T. 1927, p. 196.

** Thompson, D'A. W., 1918, pp. 197, 221, 230.

official Blue Book*. Fin Whales and Sei Whales were very predominant throughout, off the Shetlands, and the same species, with a fair number of Blue Whales, off the Hebrides. Humpbacks were best represented off the Shetlands, but the number was small.

(c) Ireland, West coast †.

Whaling during recent years on this coast has resulted principally in the capture of Fin Whales; but there have been a comparatively small number of Blue Whales, Sei Whales, Humpbacks, Sperm Whales, and Biscay Whales.

(vi.) Færoe Islands ‡.

(a) Norwegian Station.

42 whales; 1,282 barrels.

38 Fin Whales; 4 Sei Whales.

(b) Danish Station.

129 whales; 3,512 barrels.

118 Fin Whales; 5 Sei Whales; 3 Humpbacks; 2 Sperm Whales, 1 Blue Whale.

(vii.) Norway, west coast §.

The combined results of four Companies are as follows:—

574 whales; 13,060 barrels.

Fin Whales, 376; Sei Whales, 188; Humpbacks, 3; Sperm Whales, 2; Lesser Rorquals, 4; Bryde's Whale 1 (!).

The Bryde's Whale was reported by Brødrene Saebjørnsen's Company||, and the record can hardly be accepted without confirmation. The Lesser Rorqual is a common North Atlantic species, but it is the smallest of the Rorquals and is rarely molested by whalers. It not infrequently enters the Norwegian Fjords, where it was formerly caught with the aid of poisoned arrows.

(viii.) Spitsbergen.

About 1,000 barrels, which would correspond with 25 whales at an average of 40.

Details have not been found for 1926, but in 1927 the figures were 44 Fin Whales and 7 Blue Whales, giving a total of 51 and an oil-production of 2,008 barrels ¶.

Modern whaling was commenced at Spitsbergen by Svend Foyn in 1890 **, and in 1905 seven Norwegian expeditions were at work there, using floating factories. It would have been interesting if the new exploration of the waters of Spitsbergen had resulted

* Rep. Fishery Board Scotland, 1920, p. 16.

† Brit. Ass. Reports, 1913, 1915, 1916; Risting, S., 1922, p. 241.

‡ N.H.T. 1926, p. 191; 1927, p. 16.

§ N.H.T. 1926, pp. 191, 192; 1927, pp. 31, 64.

|| N.H.T. 1927, p. 64.

¶ N.H.T. 1927, p. 185.

** N.H.T. 1926, p. 167; Risting, S., 1922, p. 244.

in the rediscovery of the Greenland Whale in its bays, or at least in the open water outside: but there appears to be no hint of such a discovery.

The list which I have taken as the basis of this analysis contains no mention of Iceland, where modern whaling has been carried on, or of the Azores, where a certain number of Sperm Whales are still captured. The statistics for 1889 to 1900, for Iceland*, show a predominance of Blue Whales and a considerable proportion of Fin Whales:—Humpbacks and Sei Whales having been caught in smaller numbers.

12. *Distribution of Whales, mainly as shown by the above records.*

A. *Blue Whale.*

This species is the preferred object of pursuit by modern whalers. It is the largest and therefore the most productive of all the whales; and wherever it occurs it is eagerly hunted. It is still to be found in very large numbers in the Antarctic area. It is the preponderating species, at present, in the Ross Sea, and it is also numerous in the Dependencies of the Falkland Islands. In warmer waters it is caught in considerable numbers off Cape Colony, but less frequently off Natal. It is still numerous as far as Walvisch Bay (22° – 23° S.), on the West African coast, and even as far as Angola (13° – 14° S.), but it has practically disappeared in the French Congo, immediately south of the Equator. In the Pacific it extends up the coast of Chili and Peru, where it is abundant, and even as far as Ecuador, on the Equator—to the north of which it seems to be common off Lower California. The present records give little information with regard to its distribution farther north in that Ocean, but the N. Pacific "Sulphur-bottom," described by Seammon†, is generally regarded as the Blue Whale, and a certain number of Blue Whales are said to be captured by the whalers of Japan and Korea. Risting‡ states that the Norwegian Companies have hardly met it on the coast of Kanc area, a fact which is surprising. On the Atlantic side it occurs off Iceland and Spitsbergen and was formerly caught in the Varanger Fjord, in the north of Norway. A certain number have been captured by the Scottish and Irish stations, but it seems to be rare on the coast of Spain and it does not enter the Mediterranean.

The Blue Whale is specially dependent on certain small

* Risting, S., 1922, p. 174.

† Seammon, C. M., 1874, p. 70, pl. xiii. The description given by Seammon does not completely agree with that of the Blue Whale in respect of the coloration, though the yellow colour of the ventral surface may be due to the presence of a Diatom-film, and of the shape of the flippers. The Sulphur-bottom is said to throw its tail-flukes high above the water when it sounds, and this is not typical of the Blue Whale. Andrews (1916), pp. 178, 179, remarks, however, that a Blue Whale behaves in this manner in rare instances; but the context suggests that this statement may refer to whales observed in the N. Pacific.

‡ Risting, S., 1923, p. 33.

Crustacea for its food, the distribution of which is doubtless largely responsible for its own wanderings.

B. *Fin Whale*.

This is the species which most frequently occurs in the whaling returns. It is second in magnitude (among Rorquals) to the Blue Whale, and it reaches a considerably larger size in the Antarctic than in the Northern Hemisphere*, a conclusion which is supported by the whaling returns in the British Museum. It seems to be more numerous than the Blue Whale in Antarctic waters, though in certain seasons it is surpassed by that species. Off Cape Colony it occurs in about the same number as the Blue Whale, and off Natal it is rather more numerous. It is much less frequent than the Blue Whale off Walvisch Bay and Angola, though this fact does not necessarily imply that it cannot go so far north, and may be merely due to a difference in the migration routes. It does not occur in the returns from the French Congo. In the East Pacific it is frequent off Chili and Peru; and, according to these records, it is the prevalent species off Ecuador, where a high proportion of the individuals are very young. It appears to be rare off Lower California, but it is reported in considerable numbers from Japan and Korea, and off Kamchatka. In the Atlantic area it is certainly the predominant species, as shown by the returns from Spitz-bergen, Norway, the British and Færoe Islands, and the coasts of Spain and Portugal. The Fin Whale enters the Mediterranean in some numbers.

C. *Sei Whale*.

This species is probably confused with Bryde's Whale in some of the returns. It is found rather further from the poles than the Fin Whale, as a general rule, and is thus specially numerous off such localities as Cape Colony, Natal, and Angola in the south, and Japan and Norway in the north. It appears in tropical records from the French Congo and Ecuador. The fact is mentioned above (p. 79) that the numbers of this species in successive seasons are often very unequal. Like the Blue Whale, it feeds specially on certain small Crustacea, and their occurrence, no doubt, influences its own distribution.

D. *Bryde's Whale* †.

Bryde's Whale is best known from Cape Colony, but it has been recorded from Natal, Angola, Grenada (West Indies), Lower California, and Norway. The single record from Norway seems very doubtful, and those from Lower California at least require confirmation of the correctness of the determination. It is clear that whalers generally have not at present had sufficient experience to enable them to distinguish it from the Sei Whale, but it appears to deserve recognition as a distinct species.

* Risting, S., 1928, p. 33.

† See Olson, O., 1913, and N.H.T. 1926, pp. 82-93.

E. Humpback.

As pointed out above (p. 68), the Humpback is usually the first whale to disappear or to become uncommon soon after the commencement of operations in a new whaling field. This has been specially evident in South Georgia, the South Shetlands, Natal, and other parts of Africa, in all of which the newly introduced whaling industry was at first based on the Humpback, which often constituted 90 per cent. of the total catch*. There are few localities in which it still takes the first place, but it retains a predominant position in the French Congo and in Lower California, and is still important in Australia, Peru, Natal, Walfisch Bay, and to a lesser extent in Japan. It has not been an important constituent of the catch during recent years in any of the European localities; but about one hundred individuals were caught annually off the Finnmark coast in the middle of the 'eighties of last century†, and about the same number off Iceland.

F. Sperm Whale.

Of the species on which whaling was based up to the middle of the 19th century this is the only one which plays an important part as the victim of modern whaling. The naturalist may well feel that he owes much to petroleum (see p. 64). The Sperm Whale is perhaps even more ubiquitous than the Fin Whale, since it occurs in the neighbourhood of both Poles, and is recorded from time to time at nearly all the whaling stations, even though the number at many of them is insignificant. Its home is in the Tropics and the warmer Temperate seas, and those which occur in the high latitudes of both Hemispheres are nearly always old males which have left the society of the females and have adopted a wandering life. I do not know of records of the Sperm Whale in the Ross Sea, but moderate numbers have been taken off South Georgia and even off the South Shetlands and the South Orkneys. In the north a few appear in the returns from Kamchatka, during the season under special review. On or near the Equator, the French Congo reports it in moderate numbers, and in a general article on Ecuador whaling‡ the Sperm Whale is described as the commonest species. It is relatively abundant off Australia, Japan, and Natal; and a fair number appear in the records from Angola, Cape Colony, and Chili in the south, and from Portugal, the north coast of Spain, and the Straits of Gibraltar in the north. A Sperm Whale industry has existed in the Azores for many years, and the species appears in the current returns from Norway, the Færoe Islands, and the British Islands.

G. *Greenland Whale.* See p. 56.

H. *Biscay Whale.* See p. 53.

I. *Southern Right Whale.* See p. 64.

J. *North Pacific Right Whale.* See p. 65.

K. *Pacific Grey Whale.* See p. 66.

* See Risting, S., 1922, p. 514, for the numbers caught by a whaling company off Angola, 1910-1914.

† Collett, R., 1912, p. 612.

‡ N.H.T. 1926, p. 111.

GENERAL CONCLUSIONS.

My object in this address has been to record facts which bear on the probable future of the whaling industry. I am convinced that the present rate of killing is too high, and I have summarised the evidence on which this conclusion is based, frequently quoting the actual words of whalers and naturalists who have expressed themselves in the same sense. To the naturalist the extermination of a species must appear a crime, unless it is definitely warranted by the necessity of removing it in the interests of humanity. There is no such motive in the case of the large whales, against which the worst charge that can be brought is well expressed by the often quoted couplet:

"Cet animal est très méchant,
Quand on l'attaque il se défend."

The whaling industry has the most practical reasons for wishing to avoid an undue reduction of the stock of whales, but it is inclined to take what appears to me too optimistic a view of the future. It is maintained, on its behalf, that the expenses involved in an expedition to the Antarctic, for instance, are so great that whaling will cease to be profitable long before the whales are in danger of extermination. I admit the force of this argument, but, on the other hand, a species which has been reduced in numbers beyond a certain point has sometimes failed to recover, and the continued reduction has been followed by extinction, perhaps aided by disease or some other unfavourable condition of the environment.

History shows in the clearest way that whaling operations have repeatedly been responsible for a very serious reduction in the number of whales. It is also evident that when a species of whale has been finally driven from a particular locality it may show more than a reluctance to return to it. This fact may in itself constitute a danger to the species greater than the actual reduction in the number of individuals. It may be presumed that the reason for the selection, by various species of whales, of certain sheltered bays as suitable localities for bringing forth their young was that those bays were the best places available for this purpose. The habit of the Pacific Grey Whale of repairing to the lagoons of California, of the Southern Right Whale of visiting the bays of Cape Colony and New Zealand, and of the Greenland Whale of entering the bays of Spitsbergen, may be cited as illustrations of this practice. The Humpback appears to have a similar preference, and for the same reason, for certain bays on the West Coast of Africa: and an apparent preference for warm water by the young of Fin Whales and Blue Whales is referred to on p. 82, under Ecuador. Is it not possible that the departure of whales from their natural breeding places, which had presumably been used by them for centuries before the advent of human enemies, is in itself a peril to the welfare of the species? It may be inferred that many of the larger whales are at present carrying out one of the most important parts of their reproductive process in conditions less favourable to them than those they formerly enjoyed. The

Greenland Whale has been specially slow in showing signs of recovery, although it is many years since it has been hunted on a large scale. The fact that the comparatively few survivors do not repair to the bays they formerly frequented on the shores of Spitsbergen and Jan Mayen may place them at a disadvantage which makes recovery of numbers a difficult process.

I cannot doubt that the intensive whaling now carried on in the Antarctic area will, sooner or later, repeat some of the history of the past, even if it merely continues at its present rate. The new danger of the successful operations of large pelagic whaling ships, unfettered by restrictions which could only be imposed by International consent, gives rise to special anxiety. Perhaps the most that the naturalist has to hope for is that the final collapse will come at an earlier stage than in the northern whaling fields. The Antarctic localities are very distant, and the expenses of an expedition are correspondingly high. The point at which whaling ceases to be profitable may accordingly leave a larger residue of whales than have remained on the conclusion of former enterprises. The process of recovery would thus start at a higher level, but it may be feared that any substantial improvement would be followed by a new era of destruction.

The best object-lesson of the past is perhaps that of the Southern Right Whale (see pp. 64, 65). This animal appears to have formerly occurred in a profusion as remarkable as that of the Humpbacks and Rorquals of the Antarctic at the beginning of the 20th century. It lived in seas practically illimitable in extent, as its home was in the great Southern Ocean, which is still inhabited by those whales which are now the object of the modern whalers' pursuit. The belief that it would be impossible to exterminate the Right Whales which occurred in immense numbers in so large an area may well have been present in the minds of the old whalers. If there are any of their modern successors who think that the stock of Antarctic Rorquals is inexhaustible, the consideration of the history of the Southern Right Whale, an animal which similarly inhabited the Southern Ocean, might perhaps induce them to feel some doubts on the subject.

The 'Discovery' Expedition is engaged in the important work of investigating the species of southern whales and of studying their ecology. It may be hoped that the results of this enquiry will be of great assistance in deciding the problem of the best way to treat whaling in the future: whether it can be permitted to continue at its present rate, whether any expansion of the industry is permissible, and what are the conditions under which it should be conducted in the future, especially if further restrictions prove to be required. Naturalists and whaling companies are or should be equally interested in avoiding disaster. I am glad to be able to acknowledge the fact that the whaling industry is doing its best to co-operate with the 'Discovery' Expedition, by providing facilities for research on their ships and factories, by collecting

material for investigation, or by sending returns of the results of their operations.

Although it is hardly within the province of this Address to discuss practical measures for avoiding too great a reduction of the stock of whales, I venture to call attention to one or two points.

The Sperm Whale differs from all others in two important respects. It is polygamous, and the males are approximately twice as long as the females. The male is said to reach a length of 70 feet (although it seldom exceeds 60 feet in modern returns) and to yield as much as 120 barrels of oil. The female does not greatly exceed 35 feet in length, and although it may produce 50 barrels, it is stated that full-grown females do not average more than 15 barrels*. These statements are exactly in accordance with the theoretical conclusion that if the male is twice as long as the female it ought to produce 8 times as much oil, since the volume increases as the cube of the linear dimension. Here at least a practical method of protection suggests itself. The imposition of a size limit of, say, 35 feet would protect nearly all the females (and, of course, the young of both sexes), leaving the pursuit of the more valuable males open to the whalers. In view of the polygamous habit of this species many of the males can be spared, and, indeed, Sperm Whales which wander very far from the Equator seem to be always old individuals of this sex. The policy of killing only the superfluous males of a polygamous species has been applied with great success to the protection of the North Pacific Fur Seal.

There is at present much unnecessary waste of material, due to several causes; and this is a point of the highest importance.

(a) *Failure to utilise the entire carcass.*

The easiest and most profitable operation in a whaling factory is the stripping or "flensing" of the blubber and the extraction of the high percentage of oil which occurs in this part of the animal. In the earlier years of whaling at the South Shetlands, little more than this was attempted, and the shore became littered with numbers of the flensed and wasted carcasses of whales. Even now, at well-appointed land factories, there is a tendency, when whales have been brought back in unduly large numbers, to carry out merely the more profitable and easily performed parts of the manufacturing process, and to make an incomplete use of the remainder of the carcass. It is found, by an examination of the statistics, that a large catch of whales is frequently accompanied by a low oil-average, and that a small catch results in a more economical use of the material. The licences for South Georgia provide that the entire carcass must be utilised, and this implies drying the muscles, bones, and other parts, and grinding them into "guano" and other

* Clark, A. H., 1887, p. 72.

products. It is unfortunate that these processes cannot be fully carried out at sea, and the operations of the floating factories are accordingly more wasteful, as a rule, than those of the shore stations.

(b) *Poor condition of certain whales, and young individuals.*

The great feeding-grounds of whales are in the cold water near the Poles, where the supply of plankton is specially plentiful. Whales thus improve in condition when they reach high latitudes, and their oil-productivity increases. In warmer waters, where food is relatively scanty, they are often in poor condition and their yield of oil and other products is correspondingly low. Risting states* that "the farther we proceed northwards, especially on the West Coast [of Africa] the more young whales predominate, in some cases quite young animals. It is rarely that we find fully grown, fat valuable animals."

It would be an undoubted advantage if whaling (except in the case of the Sperm Whale) could be restricted to the colder waters. This would have the effect of protecting adults in poor condition and many, if not the great majority, of the breeding individuals and their young, since there is reason to believe that most species resort largely to warmer water to bring forth their young and probably to pair. There would, unfortunately, be great practical difficulty in securing a general agreement to this self-denying ordinance.

(c) *Capture of immature whales.*

It is clearly extravagant to kill several small whales in order to obtain an amount of oil and other products which can be prepared from a single individual of larger size. Risting† gives 70-80 barrels as the average yield of a Blue Whale, but he states that 305 barrels have been obtained from a single individual of this species. The destruction of small whales is going on at certain localities which are mainly frequented by small individuals‡, but it also occurs at others where large whales can be caught.

An examination of the oil-averages (see pp. 76, 77) shows that many localities obtain poor results. This is partly due to the causes indicated above; and partly, no doubt, to inefficient machinery and boilers. It may, of course, be due to the fact that most of the whales caught belong to species of small size. Risting§ gives the formula for oil-production: 1 Blue Whale = 2 Fin Whales = $2\frac{1}{2}$ Humpbacks = 6 Sei Whales. On pp. 39-49 he tabulates the yield of oil of various localities after reduction of the whales to "Blue Whale units." The result is in many ways instructive, but it somewhat masks the important fact that certain localities which show a good oil-average, as expressed in terms of the Blue Whale, have to kill a large number of the smaller species of whales to obtain this result.

The future is full of anxiety, and I cannot feel that an attitude

* Risting, S., 1928, p. 37.

† *Ibid.* pp. 40-41.

‡ *Ibid.* p. 34 et seq.

§ *Ibid.* p. 41.

of facile optimism is justified. It is not easy to reconcile oneself to a policy which involves making the largest possible profits without regard to the consideration that the method employed may involve the reduction of the whale-population of the world to a mere fraction of its present magnitude. Should the investigations now in progress lead to the conclusion that the danger is a real one, it is to be fervently hoped that whalers will unite with naturalists in seeking some method by which it may be averted.

APPENDIX.

TOTAL CATCHES, ANTARCTIC AND SOUTH AFRICA*.

	Season.	Right Whale.	Sperm Whale.	Blue Whale.	Fin Whale.	Hump- back.	Sei Whale.	Bryde's Whale.	Bottle- nose.	Total.
SOUTH GEORGIA †.	1909-10	37	4	26	58	3,391	—	—	—	3,516
	1910-11	79	—	85	168	6,197	—	—	—	6,529
	1911-12	82	4	298	516	5,635	—	—	—	6,535
	1912-13	6	9	317	2,157	2,360	1	—	(1)	4,850
	1913-14	66	21	940	1,716	512	94	—	—	3,349
	1914-15	20	1	2,313	1,940	823	—	—	—	5,097
	1915-16	12	1	3,026	2,744	1,578	—	—	—	7,361
	1916-17	12	35	2,440	1,606	378	—	—	—	4,471
	1917-18	35	37	1,871	1,144	60	49	—	—	3,196
	1923-24	—	46	1,926	1,375	131	195	—	—	3,673
	1924-25	—	24	3,514	2,017	262	1	—	—	5,818
SOUTH SHETLANDS ‡.	1925-26	—	15	1,845	5,713	237	9	—	—	7,819
	1926-27	—	17	3,670	1,147	—	370	—	—	5,204
	1911-12	17	—	892	1,727	2,174	—	—	3	4,813
	1912-13	3	—	1,761	2,300	976	—	—	4	5,044
	1913-14	3	—	1,472	2,092	977	—	—	—	5,259 §
	1914-15	2	—	1,796	1,679	656	—	—	—	4,133
	1915-16	6	3	1,845	2,358	219	—	—	—	4,431
	1916-17	—	—	1,380	602	21	—	—	—	2,003
	1917-18	13	—	397	627	71	6	—	—	1,114
	1923-24	12	19	1,369	1,559	98	2	—	2	3,061 +3
	1924-25	—	42	1,642	1,948	100	—	—	—	3,732
SOUTH ORKNEYS.	1925-26	—	29	2,157	2,390	165	4	—	1	4,746
	1926-27	—	23	1,275	3,442	94	2	—	2	4,838
	1923-24	—	—	210	82	3	—	—	—	295
	1924-25	—	—	189	314	4	—	—	—	507
	1925-26	1	1	44	573	4	—	—	—	623
	1926-27	—	—	284	301	4	—	—	—	589
CAPE COLONY.	1923	1	30	669	460	13	128	11	—	1,312
	1924	—	34	505	570	19	367	51	—	1,546
	1925	—	60	783	694	9	21	12	—	1,579
NATAL.	1923	—	73	210	331	106	63	—	—	783
	1924	2	256	169	353	187	56	—	—	1,023
	1925	—	511	240	254	167	112	—	—	1,284
	1926	1	466	214	336	124	97	—	—	1,238
	1927	—	408	220	287	84	89	1	—	1,089

* The figures for Natal, 1926, are from N.H.T. 1927, p. 32; for Natal, 1927, from N.H.T. 1928, pp. 35, 82. Those for 1923-24 to 1926-27, and 1923 to 1925, all localities, are from papers in the British Museum (Natural History).

† Risting, S. 1922, p. 465 (1909-10 to 1917-18).

‡ *Ibid.* p. 467 (1911-12 to 1917-18).

§ This total (5,259) includes 715 whales the species of which had not been recorded.

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[See also BOLAU, H., 1885, "Ueber die wichtigsten Wale des Atlantischen Ozeans und ihre Verbreitung in demselben." Segelhandb. f. d. Atlantischen Ozean herausg. v. d. Deutschen Seewarte, pp. 353-365 (with Plate).

Second Edition, 1898, with Folio Atlas, 1902.—Plate 39, distribution of Whaling grounds.

First Edition of text and Second Edition of Atlas consulted at the Admiralty Library during the correction of the proofs.

S. F. H., Oct. 2, 1928.]

Recent Advances in Limnology.

By K. MÜNSTER STRÖM, D.Ph.

(With 8 Text-figures.)

[Read 15th December, 1927.]

IN the broader sense of the word, *limnology* embraces all the physiographical and biological disciplines connected with fresh waters. In a stricter sense, however, limnology is a separate synthetical *science*, the subject of which is the study of reciprocal action of freshwater biotopes and biocenoses, and the cycle of organic substances within the microcosms represented primarily by the lakes.

In the possibility of regarding each lake as a more or less closed system, a microcosm, lies the special advantage of limnology for the solution of the great general questions of biology, an advantage which is shared neither by the subaërial biotopes nor by the sea.

Only for a few years has limnology been established as a synthetical science, but during that time the progress has been so great that in biology only the rate of advance in genetics is comparable.

It is impossible for me in a short address to cover the whole field of limnology; but a central theme for which all the separate disciplines furnish materials is the establishment of natural lake types; a question which must be a primary one when the lakes are regarded as units, which can be said to carry out life processes comparable to those of living organisms.

How shall we arrive at a natural classification of the hundreds of thousands of lakes scattered over the surface of the Earth?

Here, of course, we have the two great opposed principles of all classifications. Is it possible to make up a scheme into which the single phenomena can be naturally fitted? or must we go the other laborious and tentative way, first really to know each single lake, then to classify the nearly-related lakes into small groups, and then into a steadily decreasing number of larger groups until we reach the ultimate system of a few large divisions?

Is it permissible to use the bolder method, or must we await the patient investigations of generations to come?

I was formerly inclined to answer the first question in the negative, but have been convinced that a natural scheme is possible, and that the lake types originally established by Thienemann and Naumann some ten years ago are not only convenient for practical purposes, but are also natural in the sense that they cover all biological and physiographical facts observed in the temperate lakes, and that the biotopes and biocenoses in reciprocal action, that is the lakes as wholes, belong to two or three fundamental types.

Before the publication of the works of Thienemann and

Naumann which established limnology as a science, the best attempts towards a natural classification of lakes were made from a geophysical point of view; indeed, many purely physiographical systems have great advantages in clear and easy definitions, but limnologically speaking they are of very limited value, as they ignore the present life in the lakes.

Starting from a biological point of view, schemes of classification were nearly always based upon the plankton communities, but failed through grasping single points of the whole system only. The plankton is not the best indicator to the general character of a lake—at least not when only qualitatively studied, as the different organisms react to very slight differences in the properties of the milieu; maximum and minimum quantities of silica, lime, iron, or even manganese are evidently determinates for a great number of phytoplankton organisms.

On the other hand, the bottom fauna is not influenced to the same degree by the minor variations, which are partly of seasonal occurrence; it must at least provisionally be regarded as the best biological indicator of the general nature of a lake. But, indeed, the more sensitive organisms of the bottom fauna, especially the chironomids, were very little known until the fundamental investigations of Thienemann were published. In American lakes, however, the vertical distribution of oxygen during the summer stagnation period had been extensively studied by Birge and Juday, and the differences between what was called the Baltic and subalpine types were known.

No conception of the possibility of a natural division of lake types on this basis was yet founded, and it remained for Thienemann and Naumann working, the one from the point of view of the bottom fauna and oxygen contents of the bottom layers, the other from the production biology and bottom deposits, to establish the biological lake types.

In the Eifel district there are a number of small lakes—old craters—and during his work there Thienemann found that they could be classified into two types, one with, during the summer stagnation, relatively high contents of oxygen down to the bottom and a bottom fauna with the chironomid *Tanytarsus* predominant, the other with the bottom waters poor in oxygen and with *Chironomus* larvæ as the leading species. These observations concerning the two lake types were repeated in other districts, and thus the primary division into the oligotroph and eutroph lake types were established. Simultaneously Naumann studied the bottom deposits and production biology of Swedish lakes, and on this base was also able to recognize the two main types, to which he added a third, the dystroph lakes or brown-water lakes rich in humus. In order to understand the different factors which determine the character of a lake, we should be acquainted with Naumann's method of expressing them through the so-called milieu spectra. Thus we can express the main factors easily by saying that the Ca, P, N, or

humus factor is present in the oligo-, meso-, or polytype. We must also realize that during the summer a discontinuity layer is formed in most temperate lakes, so that during the period of production the lakes are divided in two strata, *epilimnion* above and *hypolimnion* below the discontinuity layer.

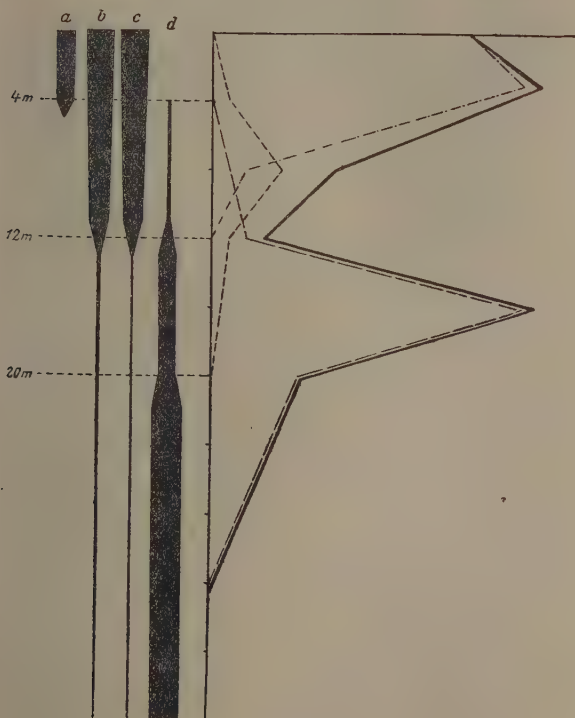
Based on these primary investigations by Naumann and Thieue-mann, and the interesting results recently brought forward by Alm, Alsterberg, Koppe, Lundbeck, Utermöhl, and others, we can now try to characterize the three main types of lakes as oligotroph, eutroph, and dystroph, though I must make the reservation that the last-named very probably cannot be established as a type of the same rank as the oligotroph and eutroph, but either lower or higher.

The words eutroph and oligotroph can shortly be defined as rich or poor in nutritive matters, but the definition would involve only the use of new words for well-known notions. The terms eutrophy and oligotrophy can indeed be used freely for many types of fresh waters, the boundary-line between them being expressed by an arbitrary limit, for instance of dissolved nitrogen compounds. When applied to *lakes*, however, they have a much deeper significance, and express fundamentally different conditions in the lakes regarded as wholes.

The typical *eutroph* lakes are relatively shallow with well-developed submerged beaches and rich littoral vegetation with a distinct zonation towards the depth. The colour of the water is greenish to yellow-green, the slight yellowish tinge being characteristic, the transparency never very great and sometimes exceedingly small. The water contains considerable quantities of nitrogen compounds and phosphates, and as far as known is rich in lime. Humic substances are absent. The plankton is quantitatively richly developed, and the bottom ooze is strongly putrefying. On account of the relative shallowness and the configuration, the hypolimnetic body of water is small compared with the epilimnetic. As the quantities of plankton sinking from the surface downwards are great, and the ooze strongly putrefying, the oxygen contents in the bottom water (in the lakes that are so deep that the discontinuity layer does not touch the bottom) are small during the æstival stagnation; or there is no oxygen at all, the oxygen contents in the deeper layers usually ranging from 0 to 40 per cent. of saturation. The bottom is populated by *Chironomus* associations, which have but small requirements as to oxygen, and are poor in species, but rich quantitatively except where the mud is too strongly putrefying. The pelagic *Corethra* larva is common. In winter the distribution of oxygen varies according to the average depth; in the deeper lakes the oxygen contents are fairly high, even in bottom layers, but in the more shallow ones oxygen may eventually be wholly absent. The hibernal consumption of oxygen is caused by the putrefying bottom ooze. According to the different oxygen percentage, the bottom-fauna

varies; where oxygen contents are small only *Chironomus plumosus* is found, otherwise also *Chironomus Liebeli-batophilus* occurs. An illustration of the depth distribution of animals together with essential factors in an eutroph lake is given after Lundbeck (fig. 1).

Fig. 1.



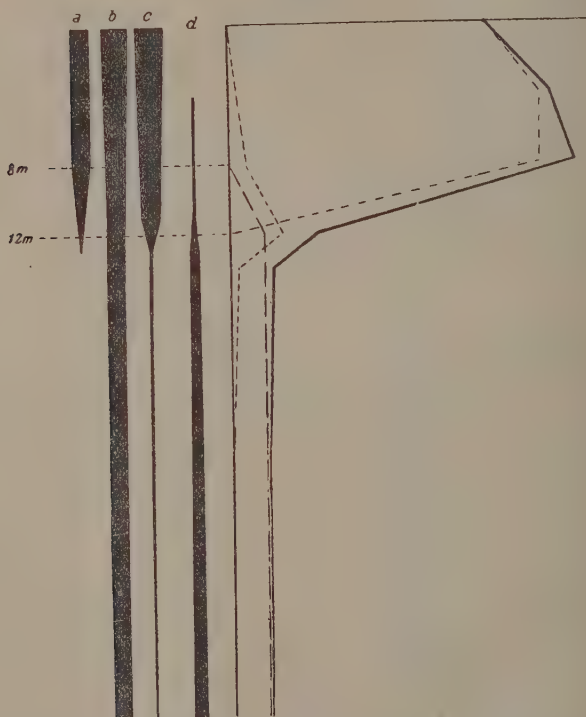
Ideal curve of depth-distribution of the bottom-fauna in a typical eutroph lake, with the governing factors. - - - - - littoral animals, ... sublittoral animals, ——— deep-water animals, ——— total. *a*, plant growth; *b*, oxygen content; *c*, temperature; *d*, ooze deposition. (After Lundbeck.)

These lakes as a rule are rich in lime, and the remarkable phenomenon occurs that the lime in the pelagic region is precipitated on account of the carbon-dioxide requirements of plankton algæ, that cannot be satisfied by the free carbon-dioxide in solution.

It is precipitated as CaCO_3 crystals, which sink downwards into the hypolimnetic strata, where they are again dissolved in the water rich in carbon dioxide.

The typical *oligotroph* lakes are deep, with submerged beaches narrow or absent, inconsiderable or no littoral vegetation, and an indistinct littoral zonation. The water is blue or green, and when

Fig. 2.



Ideal curve of depth-distribution of the bottom-fauna in North German oligotroph lakes. The line ending at "12m" is the curve of littoral animals. For other explanations of references see fig. 1. (After Lundbeck.)

not mechanically disturbed is very transparent; it contains small quantities of nitrogen compounds and phosphates, but can be rich or poor in lime, and consequently has a phytoplankton very different in qualitative respect, but poorly developed quantita-

tively. Humic substances are absent. The bottom ooze is not putrefying, or very slightly so, and as on account of the depth the hypolimnetic body of water is great compared with the epilimnetic, the dead plankton sinking down has a large volume of water from which oxygen can be drawn; therefore oxygen content in the hypolimnion does not fall very low during the æstival stagnation period, only to 70 per cent. or eventually 60 per cent. of the saturation. The hibernal oxygen-stratification is the same as in summer. The bottom is populated with the oxygen-needing *Tanytarsus*-associations, rich in species and as a rule also quantitatively rather well developed. An illustration—corresponding to the preceding one—of the depth-distribution of animals together with the essential factors in a North German oligotroph lake is given after Lundbeck (fig. 2).

The *dystroph* lakes are, even at a glance, distinguished from the two first in that they are not clear-water lakes, their colour being yellow or even brown, and the transparency small. Their basins may have the configuration typical of either the eutroph or oligotroph lakes, but in no case is the littoral vegetation rich. The transparency of the water is always small, and largely determines the paucity of littoral vegetation at any depth. The water as a rule is very poor in mineral salts, but rich in humic substances. The plankton is poor, especially the phytoplankton, whereas zooplankton may sometimes be present in some quantities. In the lakes surveyed, the oxygen content in the depth is as in the eutroph lakes and the bottom layers may be devoid of oxygen. The consumption of oxygen is not due to the organisms, but to the allochthonous detritus suspended or deposited on the bottom. The bottom is populated by *Chironomus plumosus* associations, but may also be wholly sterile, and the fauna is always very poor in respect to quantity. *Corethra* larvæ seem always to be present. In winter the deeper layers or even the whole lake is very poor in oxygen or frequently without any oxygen at all.

This is what may now be called the orthodox conception of the lake types. It must, however, be emphasized that there are two types of lakes which we know to exist, but which have not yet been surveyed on modern lines: namely, the large and very deep (up to more than 450 metres) oligotroph lakes poor in lime, occurring especially in Norway, and those among the large and deep Scottish lochs which have a brownish water rich in humic substances. It is probable that the inclusion of these types is likely to alter the definitions of the oligotroph lakes a little, and that of the *dystroph* materially.

Indeed, as mentioned, I think it is not very logical to maintain the *dystroph* lakes as a type of the same rank as the two others. Possibly the principal division should be into clear water and brown-water lakes; and there is much to support this point of view, as certainly the presence of humic substances profoundly alters

biological processes in a lake. I would propose the following scheme:—

Fig. 3.

WITHOUT HUMUS. Clear-water Lakes.		WITH HUMUS. Brown-water Lakes.	
With <i>pronounced</i> Oxygen Consumption.	With <i>slight</i> Oxygen Consumption.	With <i>pronounced</i> Oxygen Consumption.	With <i>slight</i> Oxygen Consumption.
Eutroph "Baltic."	Oligotroph "Subalpine."	Dystroph. The type defined.	?Dystroph — not yet investigated, probably many Scotch lochs.

Or the principal division would be:—

Fig. 4.

	EUTROPH.	OLIGOTROPH.
WITH HUMUS	"Humusschlammseen."	Dystroph.
WITHOUT HUMUS	Eutroph, s. str.	Oligotroph, s. str.

Fishery biologists have found some brown-water lakes other than the "Humusschlammseen" yielding a large fish produce, so that it is not altogether impossible that some of these may be characterized as eutroph in the strict sense of the word, even if many of the nutritive substances are merely allochthonous.

It must also be emphasized that we know very little about the humus, and certainly there seems to be a profound difference between the humic substances derived from peaty moors and those, derived from decaying leaves, which characterize some lakes in the Baltic region. For all practical purposes, however, the three-type scheme is of eminent value, and the differences between the eutroph and oligotroph types are those important for our classification.

There have been many attempts to arrive at more detailed divisions by Naumann, Koppe, Lundbeck, and others, but frequently they are in many respects too subtle.

Basing my conclusions upon the essentials of the Ca, N+P, and Humus spectra, I venture to propose an alteration of Naumann's schemes, which may be of programmatical value. Certainly all the types as yet known fit very easily into this

scheme, and the relation of different plankton communities can be plainly seen. The scheme runs thus:—

Fig. 5.

+(N+P). Fundamentally <i>Eutroph.</i>		-(N+P). Fundamentally <i>Oligotroph.</i>	
+Ca.	-Ca.	+Ca.	-Ca.
+HUMUS ...	Not investigated and probably not existing	"Humusschlamm- seen." Humic mud lakes.	Dystroph. lakes in Scotland and Rügen.
-HUMUS ...	<i>Eutroph.</i>	Not yet investi- gated, but al- most certainly existing.	A. <i>Oligotroph</i> lakes in the Alps.
			B. <i>Oligotroph</i> Norwegian lakes.

The principal types are in italic. The more aberrant types are the following:—The *eutroph* lake poor in lime has not yet been investigated, but there is much evidence for the belief that some of the shallow lakes situated among cultivated fields on the igneous rocks of the lowlands in Norway and perhaps Ireland may be of this type. The humic mud lakes ("Humusschlammseen") are not uncommon in Holstein, and their humus is derived from the leaves of the surrounding trees. They must generally be regarded as eutroph, and sometimes are exceedingly poor in lime. A few dystroph lakes rich in lime have been observed in Rügen and in Scotland. Their biology will certainly be a very interesting subject for investigation. Probably the lime is bound to humic acids in some colloidal form.

A little digression must be allowed, even if I am unduly emphasizing the work done by Teiling and myself in establishing the Caledonian type of plankton community. The Caledonian phytoplankton community consists of a large number of very characteristic species of algæ, especially desmids but also diatoms, Chlorophyceæ, and Myxophyceæ, and is as yet mostly known from Scandinavia, Great Britain, and North America. I have never tried to establish any "Caledonian lake" type, but only emphasized that in lakes of certain types these very characteristic plankton communities are frequently found in distinct parts of the temperate regions, and that the dogma of the ubiquity of plankton in lakes is false, as seen from the investigations by West, Teiling, G. M. Smith, and myself. What, then, are those types? They are the dystroph lakes and the oligotroph lakes poor in lime marked on the diagram (fig. 5) with an asterisk. That within those plankton communities is discernible a geographical alteration, with different species preponderant, is very probably due to the

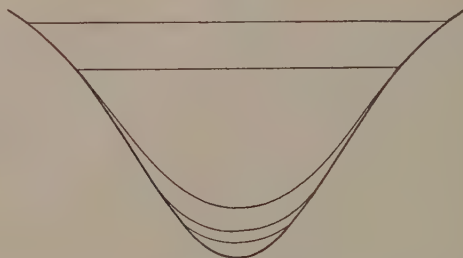
recent transformation of desmids into pelagic varieties or species, a transformation which is still in progress.

Having thus reviewed the present conceptions of lake types, we may now approach the central theme:—On which factors are the eutroph or oligotroph character of lakes dependent, and how are lakes changing during the course of time?

Very recently contributions by Alsterberg* and Thienemann have been published containing most fruitful new points of view, and have materially altered our previous ideas.

As we have seen that the oxygen stratification is the essential factor in determining life-processes in a lake, our interest is largely centred upon the problem how this stratification is established. In the general survey of lake types it has been mentioned that the dead plankton, the bottom ooze and fauna, and the allochthonous detritus are important factors in the process of oxygen consumption, but the question of their relative importance has not been considered. A few years ago Alsterberg published as results of

Fig. 6.



(After Alsterberg.)

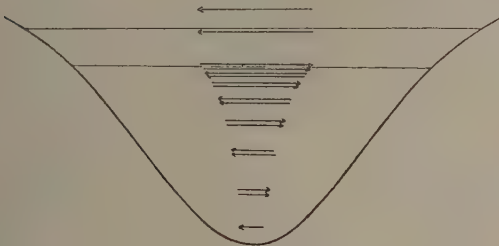
his researches the facts that the bottom ooze is quite destitute of free oxygen, and that in the water layer immediately above the ooze the oxygen is also completely consumed. The primary cause of this is the constitution of the bottom ooze of organic substances mainly derived from the plankton. This stratification Alsterberg calls the microstratification in contrast to the macrostratification already dealt with.

The primary question is now: Is the macrostratification to be regarded as a product mainly of the microstratification: and, if so, what dynamic forces are acting in transferring the influence of oxygen consumption by the ooze throughout the lakes? Is it possible that diffusion is sufficient to explain the origin of macrostratification from microstratification? We can assume that the oxygen absorption of the ooze is a complete one—at least in eutroph lakes—and then it is possible to make a mathematical

* G. Alsterberg, "Die Sauerstoffsichtung der Seen," Botaniska Notiser, 1927.

computation which shows that microstratification could never be the origin of a macrostratification if only diffusion was working. The greatest result theoretically possible, which would be established after the lapse of infinite time, would be a constant fall of oxygen content from the top surface of hypolimnion to the bottom. The solution of the problem must be that either there is no connection between the micro- and macrostratifications, and that macrostratification is dependent upon consumption by dead plankton, or that there is an additional factor which converts microstratification into macrostratification. Alsterberg then, on the assumption that if oxygen consumption originates from factors active in horizontal planes only, oxygen stratification would also be horizontal, deduced that if the bottom is the main place for oxygen consumption, the stratification would be dependent upon the configuration of the lake basin. Temperature and oxygen determinations were simultaneously carried out in more than twenty lakes.

Fig. 7.



(After Alsterberg.)

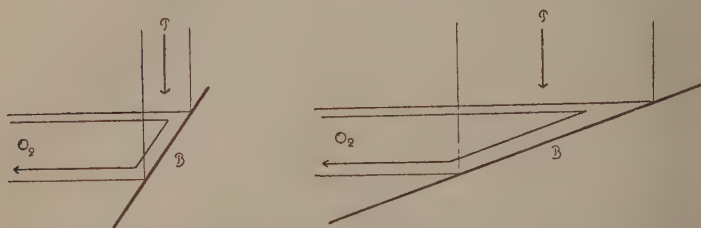
Fig. 6 conveys an idea of oxygen stratification in a small lake, Odensjön (in Skåne), which is extremely well protected against the influence of wind. As will be seen, the oxygen stratification below the thermocline closely follows the bottom configuration, whereas the thermal stratification is wholly horizontal, quite confirming the theory that the original oxygen consumption is to be found in the bottom deposits. In other lakes, however, that were not sheltered from the influence of the wind, the oxygen stratification was found to be more or less horizontal, or even inverted, in the last case on account of special bottom configuration. The explanation of this is the influence of the wind, which, as has previously been mentioned, not only affects the epilimnetic layer, but also causes secondary and tertiary horizontal currents below the discontinuity layer, as is well illustrated in fig. 7, where the upper arrow indicates the direction of the wind.

Thus we have an original microstratification originating from the bottom and causing a *primary macrostratification* following

the bottom configuration. This primary macrostratification is, however, preserved only in lakes which are extremely well sheltered against the influence of wind. Usually, through the currents set up by the wind even in the hypolimnion, or by other currents, it is transformed into a *horizontal secondary macrostratification*, which is that usually found in lakes. Thus the oxygen stratification in lakes is traced back to the consumption by the bottom-ooze and bottom-fauna principally, the additional oxygen consumption by the dead plankton sinking downwards being of comparatively small importance. In the *dystroph* lakes, however, the allochthonous detritus must cause an oxygen consumption also in the pelagic region.

Alsterberg gives an explanation which in his opinion represents one of the chief causes of the differences between the circulation of organic substance in *eutroph* and *oligotroph* lakes. A general feature of most *oligotroph* lake-basins is their great depth and steep sides. On the sides very little loose deposits can settle, and the contact area for the same stratum between the water and the bottom is much smaller, as explained by fig. 8, where the *oligotroph*

Fig. 8.



O_2 =Oxygen in a horizontal water layer. B=the bottom area corresponding to the water layer. P=the plankton sinking down on this area. (After Alsterberg.)

lakes are represented to the left and the *eutroph* to the right.

I do not think, however, that this explains so much as Alsterberg believes. It is true that the horizontal stratification emerging from the sides of the basin would not be established in an *oligotroph* lake. On the other hand, the basins of those lakes are very frequently U-shaped. On the real bottom—and the aggregated bottom areas of two lake types are by no means very different in relation to the water surface—the processes could be carried out to the same extent, if the pelagic production of the lakes were equal. Even if the extension of the stratification to *all* water layers cannot be effected to the same degree as from the sides, we should expect to find a low oxygen percentage in the bottom layers, which is not the case. So to base the difference between the lake types upon the *gradient* of the basin sides seems to be no

very fruitful hypothesis. But the gradient is the expression of another fact which we observe from the same diagram, and which we have already mentioned before—how very much greater the extent of surface and bottom is in relation to the *volume of water* in the eutroph than in the oligotroph lakes.

Here we certainly arrive at the ultimate explanation of the two different lake types, and recently Thienemann * in a most brilliant paper has shown that the average depth is the determining factor in all the lakes in Europe and North America for which data were available. That the geological substratum is not the determining factor is shown for the lakes where researches have been made; that it may be so under special conditions will be pointed out later on.

Let us, however, follow the reasoning of Thienemann:—"The indicator for the richness or poverty of a lake in nutritive substances is the oxygen content of the different layers. What organic substances are produced in the trophogenous layer (which in the larger lakes in our latitudes can be said on the average to go down to a depth of 10 metres) are more or less dissolved again in the tropholytic layers (from 10 metres to the bottom). The sinking of the content of oxygen in the hypolimnion during the climax of æstival stagnation is a measure of the amount of production in the surface strata. Further, the summer curve of the vertical distribution of oxygen in a lake is characteristic for each of the two types. In the æstival oxygen curve the type of a lake, eutroph, or oligotroph is determined."

From the large number of lakes of which records could be found, Thienemann computed the depth of the single lakes

$$= \frac{\text{volume of the lake}}{\text{surface of the lake}}; \text{ the relation of the volumes of hypolimnion}$$

to epilimnion vol. $H/E = \frac{\text{volume of the layer 10 ms. to bottom}}{\text{volume of the layer surface to 10 m.}}$

and the relation of the oxygen contents of hypolimnion and epilimnion: $O_2 H/E = \frac{\text{Oxygen contents of the layer 10 ms. to bottom}}{\text{Oxygen contents of the layer surface to 10 m.}}$

Now it was found that in the *oligotroph* lakes the volume of the hypolimnion was greater than that of the epilimnion; in the *eutroph* lakes the volume of the epilimnion was greater than that of the hypolimnion—i. e., that the ratio of lake volume to lake surface, which is the average depth, is the *determining factor for the lakes in question*. Further, he found that in *oligotroph* lakes the oxygen-content of the hypolimnion is greater than that of the epilimnion, while in the *eutroph* lakes the contrary relation was found.

The first of these two relations explains the origin of the two lake types, the second expresses the division-line between the types, a much simpler one than the contents of nitrogen compounds

* A. Thienemann, "Der Bau des Seebeckens in seiner Bedeutung für den Ablauf des Lebens im See," Verh. Zool.-Bot. Gesellsch. Wien, xxii. 1927.

previously suggested. So far the character of lakes under ordinary conditions are traced back to their morphology. Thienemann maintains that the cases where the relations between degree of eutrophy and morphology of basins are greater than here explained must be dependent upon contamination caused by civilisation. A good example of this is, the Lake of Zurich, which has undoubtedly been eutrophied by sewage supplies during the last fifty years. Many authors have endeavoured to show that the eutroph type is mainly a cultured phenomenon—I have been among them myself. Of course, there are cases where the immense amounts of nutritive salts and organic substances washed down from manured fields and the sewage of cities have determined the character even of big deep lakes, such as the Lake of Zurich; and there is evidence to show that a large number of smaller lakes may be influenced even by relatively small amounts of nutritive substances, such as is the case with lakes in Sweden, Finland, and Norway, where even the tracks of sledges in the winter can be traced in the richer development of the bottom-fauna. But those small lakes in Fennoscandia would certainly in general have been of the eutroph type, if they had been situated in moraines or loose formations; as they are situated on igneous rocks, one or more mineral salts may be present in minimum, and thus determine the production. I know a large number of Norwegian lakes with an average depth much less than 18 metres, which would be the division-line if the theories of Thienemann had universal application, where at least the plankton is typically oligotroph and very scarce. On the other hand, I have found an eutroph plankton in the shallow lakes of the virgin districts of inner Finmark situated on moraines. Further, I think that the development of the littoral zone is a factor of great importance, and that the low average depth alone will not be sufficient to explain eutrophy. A U-shaped lake of 18 metres depth with no submerged beaches would probably not be of the eutroph type. This is, of course, merely a theoretical objection, as in nearly all shallow lakes the littoral zone is very well developed. It must be mentioned, however, in order to keep open the question whether it is solely the *average* depth which is determinant, or whether the apportioning of the different depth zones, with extended shallow parts in lakes where the average depth is small, plays the deciding part. I must say that Thienemann emphasizes that his conclusions are based upon the deeper *eutroph* and *oligotroph* lakes of Central Europe and North America, and that further researches are urgently needed in deep high arctic and high alpine lakes, and shallow lakes of every kind, as well as tropical and *dystroph* lakes.

The main results of these recent studies, which will always stand unchallenged, is that all the life processes of a lake are *primarily dependent upon the shape of the lake-basin*. Preparations are now being made for investigations of tropical lakes in Java and Sumatra by Thienemann and Ruttner, and in the arctic and alpine lakes of Norway by myself, and thus we can hope that

within a few years our knowledge will be materially extended. From all our present knowledge, however, we can infer with a high degree of probability that Thienemann's conclusion, that the dividing-line between *eutroph* and *oligotroph* lakes runs where the water volumes of the epilimnion and hypolimnion are equal, will prove a universal law, provided that we except, on the one side, the lakes situated on formations so poor that the salt supplies act as a minimum factor and, on the other side, the lakes which are contaminated from cultural sources.

The natural process of the maturing of a lake is that of eutrophication. The original state of all lakes must be assumed to be oligotroph, but during the course of time there will always be a surplus of organic sediments accruing from the life processes of a lake, and the originally *oligotroph* lake is changed to a *eutroph*. The quantities of plankton, oxygen curves, and average depths are the first features to be changed; the bottom fauna the last. Many of the North German lakes are now in this stage of changing, and it is clear that a supply of nitrogen compound and phosphates from cultivated fields can do much to accelerate the change, even if it be not the main cause. When a lake has reached the real eutroph stage, the changes towards a greater degree of eutrophy are very speedily effected, indeed; the character of a lake can be materially changed within a generation. Wesenberg-Lund has given a vivid picture of the changes going on in the shallow Danish lakes. That the influence of the very highly-developed Danish agriculture compared with the rather primitive methods with large poorly manured areas for grazing, formerly prevalent in Denmark and still in Holstein, has something to do with the acceleration of the process seems certain. Finally, the *eutroph* lake disappears as a lake when the littoral vegetation has gained foothold throughout its bottom, and in the very last stage it is transformed into low moors.

The large *oligotroph* lakes such as the Swiss and Norwegian are as yet very far from the eutroph stage if only biological causes are working. Some lakes are filled up with inorganic deposits, and at the current rate of yearly sedimentation we can calculate when they will be shallow enough to approach the eutroph stage. The Lake of Constance will be filled up in 12,000 years by sediments from the Rhine, that is, it has already run through more than the half of its life. Those lakes where no such sedimentation takes place, such as many of the Norwegian, will have nearly an infinite life if only natural causes continue to operate in the future.

The *dystroph* lakes, that is the smaller among them as yet investigated, are converted into high moors by the growth of *Sphagnum*, a very different succession process from that of the *eutroph* lakes.

But even if the natural course is from oligotrophy to eutrophy, the opposite process may also be found. Gams was the first to call attention to the fact that many of the lakes which in sub-

boreal time had a very low water-level, and consequently very often an average depth that determined them as eutroph, have increased much during the great Atlantic climate change, and are now oligotroph. The palæolimnological investigations by Lundqvist confirms Gams's statements; and Lundqvist declares that for a large number of Swedish lakes the process of evolution has been from eutrophy to oligotrophy, where that process has not been checked or reversed by contamination, as he shows to be the case with quite a number of them.

Finally, before this Society, I cannot omit to point out, as indeed will be apparent from many of the facts mentioned, that the opportunities for successful limnological research are very great in the British Isles, and that many problems may be solved more easily in them than in most other parts of the world.

But progress in science nowadays largely depends upon the creation of necessary facilities for research work. The foundation of a limnological laboratory in the English Lake District or on the Scottish lochs would not only be of immense importance to international limnology, which must be regional in its methods of work, but would certainly give a great stimulus to general biological work.

OBITUARY NOTICES.

GEORGE CHARLES CHAMPION, who died at Horsell, Surrey, on August 8th, 1927, was born in South London on April 29th, 1851. While still a boy at school, he began the formation of a collection of moths and butterflies, but his attention was soon transferred to the Coleoptera, the Order of insects to which the work of his long life was devoted. The leading coleopterists of the time were not long in recognizing him as a recruit to their number of more than usual energy and discrimination, and his reputation as one of the ablest of our younger British entomologists was fully established when the turning-point of his career came in 1878. In that year he received from Messrs. F. DuCane Godman and Osbert Salvin a commission on liberal terms to proceed to Central America and to collect insect material for the monumental work on the natural history of that region which they had recently undertaken.

Such an offer was eminently acceptable to Champion, who left England early in 1879, and during the four succeeding years traversed the greater part of the Republic of Guatemala, and afterwards the Province of Chiriqui, Colombia. In his energy and success in collecting he surpassed all his predecessors, and sent home very many thousands of insects of all Orders in the best possible condition, besides numbers of other valuable zoological specimens. An itinerary of his travels in this most interesting region appeared in the 'Entomological News' for 1907, and is reproduced and extended in the Introductory Volume of the 'Biologia Centrali-Americana.'

On his return to England in 1883, Champion at once found congenial employment as secretary and chief assistant to the editors of the 'Biologia.' The preparation and arrangement of the vast mass of coleopterous material accumulated during his travels occupied him fully for several years, and he was also responsible for the volumes and parts of the great faunistic work dealing with the Heteromera, the Elateridæ and Dascillidæ, the Cassididæ, and the major part of the Curculionidæ. No fewer than 4000 species in these groups of beetles were described by him as new to science; and a volume on a large section of the Hemiptera, also including many new species, is also due to him. His share in the production of the 'Biologia' is generously acknowledged by the surviving editor in the volume which brought the great work to a triumphant conclusion in 1915.

Apart from the 'Biologia' work, Champion produced a large number of important memoirs on Coleoptera, including three contributions to the publications of our Society on the Coleoptera of the Percy Sladen Trust Expedition to the Indian Ocean. The most important of these, dealing with the Rhynchophora or weevils, appeared in vol. xvi. ser. 2 of the 'Transactions' (pp. 393-497, pls. 22-24, 1914). From 1891 onwards, he was one of the

principal editors of the 'Entomologist's Monthly Magazine,' in which a valuable series of papers on the Coleoptera of Northern India, collected by his eldest son, Mr. H. G. Champion, of the Indian Forestry Service, have appeared in recent years. In 1923 he joined the editorial staff of the 'Annals and Magazine of Natural History.'

His connection with the Entomological Society of London began in 1871, and twenty years later he succeeded the late Ferdinand Greet as its Librarian, an office which he held with distinction until 1921. He became a Fellow of the Zoological Society in 1888, and in 1897 the Linnean Society elected him as one of their Associates.

He retained his interest in our indigenous Coleoptera to the end of his life, and from their intimate knowledge of the European beetle fauna, acquired in Champion's case by many collecting expeditions to the Continent after his return from the Tropics, his lifelong friend, Dr. D. Sharp, and he were regarded as the final court of appeal in all matters relating to British beetles. His death removes from us a man of upright and amiable character, as well as a worker of unequalled thoroughness, meticulous care, and keen critical faculty, whose loss will long be mourned by a wide circle of friends and colleagues. [J. J. WALKER.]

ROBERT MILLER CHRISTY, whose death occurred on 25th January, 1928, following an operation, came of an old Essex Quaker family. He was the eldest son of the late Robert Christy, of Chignal St. James, near Chelmsford, and was born there in May 1861. From childhood he took a keen interest in Natural Science, particularly in botany and ornithology, and during his schooldays at Bootham School, York, he collected specimens in these and other branches of natural history.

Whilst still in his teens he was selected by the Tuke Emigration Committee to go to America to organise the settling of starving families sent out by the Committee during the Irish Potato Famine of 1881-2. He afterwards went to Manitoba, spending a year camping and exploring with the well-known naturalist-traveller, Ernest Thompson Seton, with whom he thus began a lifelong friendship. On his return to England he exhibited to the Society a collection of Lepidoptera and Hymenoptera which he had made in Manitoba, and in 1886 he presented some 156 plants, collected there by himself, to the British Museum.

Before this date an early communication by Christy "On the Methodic Habits of Insects when visiting Flowers" was read before the Society and published in its Journal, vol. xvii.; and a second paper by him "On the Power of penetrating the Bodies of Animals possessed by the Seed of *Stipa spartea*" was read but not published.

On 20th June, 1889, he was elected a Fellow of the Society.

Later papers read before the Society include the following:—
" *Primula elatior* in Britain: its Distribution, Peculiarities,

Hybrids. and Allies," read 17th June, 1897, published in the 'Journal,' xxxiii. 1897-8.

"Preliminary Observations on the Seasonal Variations of Elevation in a Branch of a Horse-Chestnut Tree," read 16th June, 1898, published in the 'Journal,' xxxiii. 1897-8.

"On the Definition of 'Right' and 'Left': a Problem in Scientific Terminology," read 20th January, 1916, but not printed.

"Wistman's Wood," read 3rd February, 1921, abstracted in the 'Proceedings' for November 1921.

"The Pollination of the British Primulas," read 1st December, 1921, published in the 'Journal,' xlv. 1922-24.

In addition to the above, Christy wrote numerous articles on various natural history subjects in the 'Field,' 'Zoologist,' 'Journal of Botany,' 'New Phytologist,' 'Journal of Ecology,' 'Proceedings of the Royal Geographical Society, and 'Journal of Conchology,' as well as articles on such widely-differing subjects as Manitoba, Essex Brasses, the Trade Signs of Essex, the History of Banking in Essex, Roman Roads in Essex, Fire-raising Methods and Appliances, Deneholes, and Oven Clocks. His mental versatility and wide range of interests were indeed remarkable.

Christy was an original Member of the Essex Field Club and one of its Past-Presidents, serving as President 1905-07, and as Acting-President in 1910 during the then-President's illness. For two years (1917-19) he edited the Club's journal, the 'Essex Naturalist,' and he was a constant attendant at the Club's meetings and a frequent contributor of papers over a long period of years.

In 1890 he wrote for that Club a Special Memoir on 'The Birds of Essex,' which still remains the best authority on the subject; and in 1910, in collaboration with Miss May Thresh, an exhaustive 'History of the Mineral Waters and Medicinal Springs of Essex,' which was published as another Special Memoir of the Essex Field Club.

Christy was also for many years a Member of Council of the Essex Archæological Society, and in 1910 he helped to found a working-party of archæologists, known as the Morant Club (now defunct), to do spade-work in original investigation of sites of antiquarian interest. He was also a founder of, and a frequent contributor to, the 'Essex Review.'

He was a partner in the printing firm of Hayman, Christy & Lilley Ltd., of Farringdon Road, whose business was, however, broken up during the War owing to the Government's action in commandeering it.

He was unmarried.

[P. T.]

HENRY ARTHUR ERLEBACH, B.A. (Lond.), F.L.S., F.R.G.S., was, at the time of his death on February 5th, 1928, Senior Principal of Woodford House School, Biringington. He had lived a full and active life, sharing with unflagging zeal in all the

interests of the School, and of the village where he had resided for thirty-five years. He was a great lover of nature, and nothing gave him more pleasure than rambling among the mountains of the Lake District and North Wales. Wherever he went he enriched his walks with the closest study of every form of plant-life.

In his younger days Arthur Erlebach had been an assistant master in Mill Hill School under Dr. Weymouth, and it was during that time that he and his brother Alfred helped the late Sir James Murray in his monumental work of compiling the 'New English Dictionary,' which has just reached its completion.

Arthur Erlebach was a cricketer of no mean powers, and played cricket, in the truest sense of the term, in every part in his many activities. In the village of Birchington he identified himself with the life of the place, both in the Parish Council and in numberless other less prominent ways. Many touching tributes from Old Boys of the School and from his fellow townsmen testify to the beauty of his character. [ALBERT HODGES.]

CHARLES FORD, who died at Stanmore, Middlesex, on July the 14th, 1927, at the age of 83, was for over thirty years connected with Hong Kong. Through the instrumentality of Kew he was appointed Superintendent of the Public Gardens there, and took up his duties on June the 28th, 1871. Shortly afterwards he wrote an interesting account to Sir J. D. Hooker of the condition of the Gardens and the scope of his duties. These latter included the oversight, not only of the Public Gardens, but of the Government Gardens, a vegetable garden at the top of Mount Victoria, two small nurseries, and all the trees bordering the streets, "in fact every place where any trees grow." For this task his staff consisted only of 34 coolies. The great contrast between the condition of the Gardens when he took charge and when he left in 1902 is excellent testimony of his skill and the tact with which he faced the handicaps due to changes in the Administrators of the colony, some of whom were not well disposed to botanical work.

On his arrival the Gardens were well stocked with plants as regards quantity, but not as to variety, there being no orchid or ferns except indigenous ones, while the introduced plants were chiefly from Australia and Japan, with a few from India. This state of affairs he set about to remedy, and by much correspondence succeeded in doing so. In 1873 he made a three months' tour to the northern parts of China. In 1874 he wrote to Sir J. D. Hooker about forming a herbarium, and asked for assistance in obtaining secondhand books, as the grant at his disposal would not permit of his buying new copies. In the same year, in order to enlist public interest he organized a flower show, which was repeated in subsequent years. Later in the year much damage was done to the Gardens by a typhoon. He travelled *via* Singapore to Calcutta

and inland to Cawnpore in 1876, and in March of the following year reached England on a 16 months' leave. Up to this time, as well as subsequently, he was a voluminous correspondent, and his letters abound in interesting notes on various plants. His favourite plant seems to have been *Rhodoleia Championi* (of which on one occasion he germinated 2000 seeds), for he so frequently mentions it in his letters. On his returning to Hong Kong in 1878 he expressed regret that the steamer did not stay sufficiently long at Batavia for him to visit Buitenzorg. About this time a separate officer was appointed for the Forestry Department, but the relief to work thus obtained was counterbalanced by the reduction of finances due to weekly concerts being given in the Gardens and paid for out of the garden vote. Further changes were made in 1879, when the Public Gardens were made a separate department and their name changed to Botanical Gardens. Evidently Ford's work was beginning to be appreciated, for in the next year the plantations were again placed under his charge and his salary raised by £125. He visited Dr. Hance, with whom he had previously corresponded, at Whampoo in 1882.

The herbarium, started in 1874, had accumulated upwards of 2000 specimens by 1884, and continued to increase, so that in 1890 alone 1562 specimens were incorporated in it. In 1883 he collected in Lo Fan Shan, and in 1895 in Hainan, and his specimens are recorded in the 'Index Floræ Sinensis.'

Ford introduced from the Philippines *Hedychium coronarium*, which by 1885 had become, he says, "perfectly established throughout the colony," and on account of its showy flowers and delicious perfume was much appreciated by the inhabitants. In 1886 he again came home on leave and sent specimens of woods to the Indian and Colonial Exhibition. It was not until January 1892 that an assistant, Mr. W. J. Tutcher, was appointed to share Ford's work. Ford was not a prolific author, but he published:—'A Catalogue of Plants in the Government Garden, Hong Kong' (1876); "Index of Chinese Plants" in the 'Journal of Botany,' vols. i.-xviii. (1883); "Notes on Chinese Materia Medica" in the 'China Review,' vols. xv. and xvi. (1887), and 'A Classified Catalogue of the Library of the Botanic Garden, Hong Kong' (1896), as well as some other papers. He hoped that it would have been possible to publish an annual report on the Gardens, but the handicaps above alluded to prevented this. A first report was published in 1872, but the second did not appear until 1876, followed by others at irregular intervals.

On the 31st of March, 1902, Ford retired and sailed for England, where he settled first at Ripon, and in 1913 removed to Stanmore, Middlesex; up to a short time before his death he often visited Kew. He received the Imperial Service Order and Sir J. D. Hooker dedicated vol. cxx. of the 'Botanical Magazine' to him. He was elected a Fellow of the Linnean Society on December the 3rd, 1883.

[C. H. W.]

J. A. DE GAYE belonged to an old French family living in the Island of Mauritius. He early took to an educational career in Mauritius, then in Seychelles, and lastly in Nigeria, where he became Inspector of Schools. He retired to France, where he died on the 19th of September, 1926. He was a most enthusiastic naturalist, being particularly interested in insects, but with an excellent all-round knowledge of animals and plants. His most notable publication was perhaps a *Natural History of Mauritius*, published in French. As a teacher and Inspector of Schools he was very successful, his chief interest being in the adaptation of European education to native needs, which he conceived to include an all-round knowledge and understanding of their natural environment. [J. S. G.]

SAMUEL GARMAN, one of the most distinguished of the older American ichthyologists, was born in Indiana County, Pennsylvania, June 5, 1843, and died in Plymouth, Massachusetts, September 30, 1927. Much of his life was spent in association with Louis Agassiz and Alexander Agassiz as an Assistant in the Museum of Comparative Zoology at Harvard University. The Linnean Society honoured him with election to Foreign Membership on May 5, 1921.

Of Garman's youth very little seems to be known. When he was called upon to make a statement for print about his early days, he wrote: "A life in which memories of family traditions, of grandparents and other relatives have no part, one without remembrances established and intensified for verities by heresay and repetition, like the treasures in most of the wonderful memories of children, contains little general interest to the public. Hardly a distinct recollection of childhood or a village school is left to me; all are lost or vague and dreamlike. The mists of forgetfulness obscure even the preparations for advanced education: train-boy; adzman; foreman on construction; fireman and running an engine." These are some of the faint remembrances of his early youth.

In 1870, when he was twenty-seven years old, he became principal of the Mississippi Normal School, where he remained for one year. Following this he was Professor of Natural Sciences in the Ferry Hall Seminary at Lake Forest, Illinois. After a year at Lake Forest he made his way to San Francisco, California. Here he met Louis Agassiz, who had just returned on the 'Hasslar' from his voyage through the Straits of Magellan. Garman was induced by Agassiz to come to Cambridge, Massachusetts, where he began his long association with the Museum of Comparative Zoology.

In these early days Garman took an active part in the Anderson School of Natural History, a seaside laboratory established by Louis Agassiz on the Island of Penikese, off the Massachusetts coast. This laboratory, among the first, if not the first, of its kind, was opened in 1873, and from the beginning Garman worked

there. He helped in the erection of the building that housed the school, kept the books of the Institution, and entered fully into its scientific life. In 1874 he accompanied Alexander Agassiz on his survey of Lake Titicaca in South America. He also made an extended voyage to the West Indies, whose reptilian fauna was for the time being his special interest. After his return from the south he took up as his life occupation work on the fish collections in the Museum of Comparative Zoology. Here he prepared a series of important monographs on the sharks and rays, on the fishes of the deep seas off the West Coast of Tropical America, on the frill-shark, once regarded as the oldest living type of vertebrates, and on other groups of fishes, such as the "Discoboli," the "Cyprinodonts," and the "Chimæroids." In consequence of his substantial contributions to ichthyology Garman was made a member of many learned societies. Although he had been a student in the Lawrence Scientific School of Harvard University, he never graduated. In 1898 Harvard conferred on him the honorary degree of S.B. and in 1899 that of A.M.

Garman was a man of medium size, in later life rather bent-over and spare. He loved his garden, and his work there among his plants and his bees added greatly to his physical vigour. During much of his life he was remarkably reticent both about his work and about himself. He seemed to have wished to lead the life of a recluse, and as such he died. Most that is contained in this notice comes from an appreciation of him by two of his few intimate friends, David Starr Jordan, Chancellor Emeritus of Stanford University, who knew him well in his early days, and Thomas Barbour, Director of the Museum of Comparative Zoology, who was well acquainted with him in his later life.

[G. H. PARKER.]

PETER GOYEN, who died at Dunedin, New Zealand, on July 10, 1927, was born at St. Austell, England, in 1845. He received his education at private schools in England and afterwards at St. James's College, Melbourne, Australia. For some years (1874-78) he was engaged in teaching in schools in Victoria. In the year 1878 he was appointed Inspector of Schools for the educational district of Southland, New Zealand. In 1892 he was transferred to the larger district of Otago, where he was associated with the late Donald Petrie, who was at that time Chief Inspector of the district. In the course of their work these Inspectors travelled widely throughout Otago, and had abundant opportunities of occupying their spare time in the study of the natural history of the places they visited. Mr. Goyen took special interest in the botany and geology, and at one time commenced to study the spiders, then very imperfectly known. But other duties demanded attention, and to these he devoted his full energies. As an Inspector of Schools he was exceedingly keen and thorough, and did much to improve the character of the teaching. He published several text-books on English and Mathematics, one, an Arithmetic

for higher classes, showing considerable originality and being superior to most of the arithmetical text-books then in use. After his retirement from active work he lived in Dunedin, taking interest in the local library and other matters of a literary character. [C. C.]

LINNAEUS GREENING, who was born in 1855, died at Warrington, on December 16, 1927. He had been ill for some weeks previously, and had been in failing health for some time past. Although he had long realised the significance of increasing physical disability, and in this connection his failing sight and approaching blindness were a great affliction, nevertheless he bore his troubles with a fortitude and optimism which seemed only typical of his cheerful outlook and lofty mind.

One could not be in his company without being impressed by his attributes and personality. One who knew him well has aptly expressed some of these characteristics:—"He was a man of the most sterling character, and a very fine type of an English gentleman. Transparently honest and straightforward, he had no room for shoddy either in business or in people. Insincerity and selfishness were alien to his nature, and whenever he came across them they received short shrift, sometimes very emphatically. It was very largely this granite-like quality in his character that endeared him to his friends."

Lancashire has long been noted for its many eminent disciples of Linnaeus, and the subject of this notice worthily upheld the reputation of the county. A member of an old Warrington family, his interest in natural history was clearly traceable to heredity. His grandparent was well known as a naturalist, and his father, Noah Greening, was equally zealous in such pursuit, and achieved some reputation by his entomological work. The son's interest in natural history dated from an early age, and as the years roll on we find increasing devotion to his special study. His activities took various forms, but as we glance at these we cannot fail to be impressed by the merit of his work. If we attempted to appraise Greening's work and influence we should mention his truly scientific mind. He was extremely painstaking and methodical, and always kept careful and systematic record of his work on the British fauna and flora. Outdoor work ever had a strong appeal, and he was a keen field-naturalist. Reptiles and Amphibia, Diptera, Lepidoptera, Arachnida, and Ornithology were amongst his special interests, and he accomplished valuable work here. His excellent collection of British Spiders was presented by him to the Warrington Museum, which also houses his valuable collection of Reptiles and Amphibia. The latter contains material collected in various parts of the world, and is stated to be one of the most extensive in the provinces. Some of the specimens which were sent home to him by his agents proved new to science, and it was typical of Greening that he should present these to the National Collection.

His wide interests are well reflected in the valuable series of records which, together with his library, he bequeathed to Warrington Museum. The former collection occupies nearly two hundred boxes, and embraces practically all the main sections of the plant and animal kingdoms. This includes not only his own extensive field-notes and records, but also numerous cuttings from various scientific media. He was a great student and a wide reader, and had a remarkable memory. His Fellowship of the Linnean Society dated back to 1909. He was also associated with the Zoological Society and the British Ornithologists' Union. The local Field Club claimed his active allegiance, and some of his lectures to this and other societies were published under various titles. He was a foundation member of the Lancashire and Cheshire Fauna Committee. This had his warm and active sympathy, for the systematic investigation and recording of the fauna of the two counties were ever in his mind. He was elected President of the Fauna Committee in 1927, and occupied this position at the time of his death. Only those closely associated with the work of that body realise how great a loss his removal brings. He was an ideal chairman, and rendered great practical aid to the committee. It was largely due to his efforts that it was resolved to embark on the publication of a special volume dealing with a systematic enumeration of the terrestrial and freshwater fauna of Lancashire and Cheshire. We believe that the undertaking is being actively prosecuted, and the work will appear in due course.

Greening took an active part in public life, and rendered valuable service to his town and district. The Warrington Museum always had a special place in his interests, and he was a member of the Museum Committee for the long period of 47 years. He was Chairman at different periods, and his special knowledge and the zeal he displayed in many directions rendered his services to the Museum invaluable. The Town Council also claimed him as a member for some years, and he was a Justice of the Peace for the Daresbury Division of Cheshire. He was for many years Chairman of the Warrington firm of wire manufacturers, Messrs. N. Greening & Sons, a business founded by his grandfather Nathaniel, who came to Warrington from the Tintern Abbey Wire Mills in 1799.

A man of striking character and attainment, a true naturalist and a gentleman, while we cannot help mourning his passing, we are nevertheless grateful for his example and acquaintance.

[A. A. DALLMAN.]

BENJAMIN DAYDON JACKSON. An intimate association with our Society, of nearly sixty years standing, was closed by the death on October 12 last of Dr. Daydon Jackson. Jackson was elected on January 16, 1868, in his twenty-second year (he was born on April 3, 1846), two of his sponsors being John J. Bennett and William Carruthers, respectively Keeper and Assistant of the Department of Botany, British Museum. In 1880 Jackson

succeeded Frederick Currey as Botanical Secretary, a post which he held for twenty years, his period of service being almost coterminous with those of four secretaries on the zoological side—Edward Richard Alston (1880-1), George James Romanes (1881-5), Walter Percy Sladen (1885-95), and Thomas George Bond Howes (1895-1903). As Botanical Secretary, Jackson threw himself heart and soul into the work of the Society, and it is not surprising that, with the continual changes on the zoological side, he came to be regarded as *the* Secretary. When in 1902 a rearrangement of the permanent staff became necessary, the Council gladly accepted Jackson's offer to take the senior position on the salaried staff with the title of General Secretary, and with a seat on the Council—a condition imposed by himself.

It was with some reluctance that Jackson laid down his duties, after a further service of twenty-four years, in 1926. At the date of the Anniversary Meeting he had reached eighty years of age, and although still vigorous and obviously in excellent health, his failing memory had been the cause of some anxiety to those who were working with him. Happily the way of retirement was smoothed by his appointment as Curator of the Linnean Collections, in which capacity he would still be responsible for the herbarium, books, manuscripts, and other objects in the Society's possession especially associated with Linnæus. The Anniversary Meeting in May 1926 was a memorable one; an excellent portrait of the General Secretary by Mr. Ernest Moore was presented to the Society on behalf of the subscribers by Sir David Prain, and a cordial appreciation of his long and devoted services was voiced by several of his former colleagues.

After a brief holiday Jackson settled down to work again in his old corner of the Reading Room, where his desk (his own property) had been a familiar object for as long as most Fellows can remember. But the prospect of some further years of helpful association with the Society for which we had hoped was not to be realised. On his way home from Burlington House on Saturday, October 1st, he was knocked down by a motor-car in crossing the Buckingham Palace Road, and died from the effects of the accident, in Westminster Hospital, on the Wednesday week following.

Many of his old friends and colleagues were present at the Golder's Green Crematorium on October 19 to pay their last respects to his memory and to express their sympathy with his widow.

By his natural tastes and early training Jackson was eminently fitted for the Secretaryship of a Natural History Society. Born in Southwark, and educated at private schools (our former Treasurer, Sir Frank Crisp, was, I believe, a school-fellow), he followed for some years a business career involving secretarial and accountancy work. His interest in field-botany brought him into touch with Kew and the British Museum, and, as has been indicated, it was to the officers of the Department of Botany at

the latter Institution that he owed his introduction to the Linnean Society. The brothers Henry and James Groves knew him at the South London Microscopical and Natural History Club in 1874.

From the first Jackson's interests lay on the literary side of Botany. In 1874 he wrote for the 'Journal of Botany' a sketch of the "Life of William Sherard," the first of a series of biographical essays which included a life of 'George Bentham' in the "English Men of Science Series" (1906) and an English edition of T. M. Fries's 'Life of Linnæus' (1923); also many of the obituary notices, which are a feature of the annual issue of the 'Proceedings' of our Society. The reproduction in 1876 and 1877 respectively of two rare Sixteenth Century tracts, John Gerard's 'Catalogue of Plants' cultivated in his garden in the years 1596-9, and William Turner's 'Libellus de re herbaria novus' (1538), were early expressions of his ability for editing and annotating.

Apart from his work at the Linnean Society, Jackson's chief contribution to Botanical Science was his classical works of reference. In 1881 appeared the 'Guide to the Literature of Botany,' a classified selection of the literature of the science, to which one still turns for information, and in 1882 'Vegetable Technology: a Contribution towards a Bibliography of Economic Botany.' In the same year (1882) he started on his *opus magnum*, the 'Kew Index,' which occupied the greater part of his time for a period of thirteen years and five months. In an account of this undertaking in the 'Gardeners' Chronicle' (June 26th, 1909), Jackson refers to it as "a piece of work in the service of the botanic world on which I gladly spent the best years of my life"; he also contributed a "History of the Compilation of the Index Kewensis" to the 'Journal of the Royal Horticultural Society,' xlix. p. 224 (1924). The first "Supplement" (Brussels, 1901-6) was prepared in co-operation with the late Dr. Th. Durand. Botanists nowadays take the 'Kew Index' for granted; only those who worked in taxonomy before the appearance of the 'Index' can thoroughly appreciate its enormous value as a work of reference. Another work, perhaps as widely used as the 'Index,' is the 'Glossary of Botanical Terms,' which Jackson issued in 1900; a fourth edition was ready at the time of his death and has since been published. Of special interest to our Fellows are his 'General Index to the first twenty volumes of the Journal (Botany) and the botanical portion of the Proceedings, Nov. 1838 to June 1886, of the Linnean Society,' issued by the Society in 1888, and his last important work, the new edition of the 'Catalogue of Books and Pamphlets in the Library,' issued in 1925.

Jackson's association with our Society gave the opportunity, which he used to the best advantage, of a study of the Linnean Collections and Library to the possession of which the Society owes its origin. Jackson's reputation as a student of Linneana was world-wide, and his services were constantly in requisition by

botanists in our own country and overseas. At the Bicentenary celebrations of the birth of Linnæus in 1907, in Sweden, Dr. Jackson was the most honoured guest, receiving the honorary Ph.D. and A.M. of Upsala University and the Order of Knighthood of the Polar Star. His "Index to the Linnean Herbarium with indication of the types of species marked by C. von Linné etc." (Proc. Linn. Soc. 1911-12, Suppl.), an invaluable commentary on the Herbarium, was followed (*l.c.* 1912-13) by a 'Catalogue of the Linnean Specimens of Amphibia, Insecta, and Testacea, noted by C. von Linné.' It was hoped that the comparative leisure afforded by his relief from the duties of the Secretaryship would enable Dr. Jackson to put on record more contributions from the great fund of knowledge he had acquired on Linnean matters, but to our great regret he was not spared to carry this out.

Jackson occasionally contributed papers, mainly of bibliographical interest to our Society's publications, and was a constant contributor to the 'Journal of Botany' for more than fifty years (1874-1924), mainly notes on bibliography, biography, or nomenclature; after the sudden death of his old friend James Britten, the Editor of the Journal, he, at his own suggestion, contributed the Index for the 1924 volume. Readiness to help was one of Jackson's most prominent characteristics, experienced not only by our own Fellows, more especially perhaps the younger or newer, but also by visitors from home or abroad desirous of consulting the Linnean Collections or the Society's Library. Local Natural History Societies around London found him ready to talk on one or other of his favourite topics; he joined the Quekett Club (1869) soon after its foundation, and was an Honorary Member of the Essex Field Club and a past-President of the Herts Natural History Society; for the latter Society he edited the second edition of Reginald Pryor's 'Flora of Hertfordshire.'

Jackson saw many changes in the Society during his long period of Fellowship, including the removal from quarters across the quadrangle, which now form part of the Royal Society's Rooms, to the more spacious apartments in the west wing of Burlington House, and the alteration of the plan of seating in the Meeting Room—the "desk," not the present one, which was the gift of Sir Frank Crisp, formerly stood against the long wall facing the windows. One of the most important changes was the admission of women as Fellows in 1904. In his later years of office he was inclined to resent the somewhat "revolutionary" suggestions of his younger colleagues for increasing the amenities and opportunities of the Fellows, such as removal of tea on meeting days from the inconvenient old post-office room to the Library, the provision of the Fellows' writing-rooms, and the extension of hours of opening of the Library; but a little persuasion would induce him to accept the position, and he remained to the last a thoroughly loyal and devoted servant of the Society. It is a remarkable tribute to his character that up to his eightieth year he could continue to work

with successive generations of younger men in the management of the Society's affairs and at the same time retain their respect and affection. His death leaves a blank in the Society in more senses than one—the offices of General Secretary and Curator of the Linnean Collections, which were instituted for him, have both fallen into abeyance, and his striking personality, his cheery welcome, and ready attention to one's needs are now only a memory.

To some of us who have worked with him as Officers of the Society or Members of Council his death comes as a very personal loss; to myself it is the break of an association, more or less intimate, of nearly forty years. [A. B. RENDLE.]

WILHELM LUDVIG JOHANNSSEN was born at Copenhagen in 1857. Owing to the expenses of a large family, his father, Colonel Otto J. G. Johansen, was unable to give him a University education, and on leaving school at the age of 16 he went into business, spending some years as a chemist's assistant in Denmark and Germany. In 1880 he took a pharmaceutical degree, and shortly afterwards was appointed assistant to Kjeldahl at the Carlsberg Laboratory in Copenhagen. During the six years he was there (1881-87) his main business was the study of the physiological processes in ripening barley seeds. Between 1887 and 1892 he spent much time abroad in Germany and France, and in 1892 he was appointed Lecturer in Plant Physiology at the Royal Agricultural College in Copenhagen, becoming full Professor in 1903. Two years later he was called to the Chair of Plant Physiology in the University of Copenhagen, where he remained until his death in 1927. It was while he was at the Agricultural College that he carried out the work for which he became best known; for it was here that he elaborated his well-known "ether method," and it was here that he carried out with beans the famous experiments which led to the enunciation of the principle of "pure lines"—a principle destined to exert a far-reaching influence on the practical breeding of plants.

In his later years he was attracted by the study of Genetics, and in 1909 published the first German edition of his well-known 'Elemente der exakten Erblchkeitslehre.' It was at once received as an authoritative work, and further enlarged editions appeared in 1913 and 1926. Previously he had published Danish text-books on Plant Physiology and (with Dr. Warming) on General Botany. He was always much interested in the history of scientific thought, and his last work, published in Danish in 1917, was on 'Heredity from Historical and Experimental Points of View.'

Johannsen's influence received recognition by the conferment on him of the degree of Doctor *honoris causa* by the Universities of Copenhagen, Freiburg, Groningen, and Lund. In 1906 he was awarded the Veitch Medal of the Royal Horticultural Society, and in 1917-18 he held the office of Rector of the University of

Copenhagen. Perhaps the most congenial honour of all was the dedication to him on his 70th birthday of a special volume of 'Hereditas' by his colleagues and fellow-workers of the Scandinavian Mendel Society.

Personally Johannsen was one of the most charming of men. An excellent linguist, he had travelled much, and wherever he went his quick sympathy and tact gained him the affection of all he came across. There are many who will sadly miss that wise little figure brimming over with good humour and fun.

[R. C. P.]

JOHN RUDD LEESON, who died on October 23rd, 1927, at the age of seventy-three, was the only son of John Leeson, of Davies Street, Berkeley Square, London, where he was born. His medical studies were pursued at St. Thomas's Hospital and at the Universities of Edinburgh, Vienna, and Berlin. He took his M.D. in 1882, and it was while at Edinburgh that he came under the influence of the late Lord Lister, with whom he worked for two years and whose coveted Gold Medal for Clinical Surgery he gained. In April of last year Dr. Leeson published his reminiscences of the Great Master under the title 'Lister as I knew him.'

In 1879 Dr. Leeson settled at Twickenham, and for thirty years achieved striking success as a medical practitioner, acting as medical officer of St. John's Hospital for twenty-nine years. At the age of fifty-four he retired in order to devote himself to natural history pursuits and to philanthropic work for his adopted town, and here he laboured for the remaining nineteen years of his life. In 1909 he published in the pages of the 'British Medical Journal' a paper under the title "Thirty-eight Years of Medical Life: a Retrospect and a Prospect."

During the War he served as hon. medical officer to the Auxiliary Hospital, Isleworth, also as captain in the R.A.M.C. (T.). He filled many important positions in Twickenham, including that of Charter Mayor and First Mayor, which position he held at the time of his death. He was a County Magistrate for Middlesex.

Besides being a Doctor of Medicine, Leeson was also Master of Surgery of the University of Edinburgh and a Member of the Royal College of Surgeons, England. He was a Fellow of this Society from 1892, Fellow of the Royal Astronomical Society, the Royal Microscopical Society, and a member of the Royal Institution and other scientific bodies, a member of the Athenæum Club, and a Liveryman of the Salter's Company. At the funeral the whole town of Twickenham turned out to mourn him, for the genial and inspiring personality of the Mayor, united with that of the untiring friend and Beloved Physician of former years, had endeared him deeply to all classes and callings of men.

We are indebted to Miss Leeson for assistance in preparing this notice of her father.

[A. W. S.]

GERVASE FREDERICK MATHEW, at the time of his death on February 10th last, was with one exception the oldest surviving Fellow of the Society, into which he was elected as long ago as March 17th, 1864. A member of a well-known North Devon family, which included more than one naturalist of considerable repute, he became interested in Ornithology and Entomology at an early age, and when quite a youth he contributed some valuable notes, mosly dealing with the fauna of his native county, to the 'Zoologist,' and the 'Entomologist's Weekly Intelligencer.' In 1861 he entered the accountant branch of the Royal Navy, his long and meritorious career therein ending in 1902 with his retirement, with the highest rank in his department of the service, that of Paymaster-in-Chief. Throughout this long period of active employment his unflagging energy and enthusiasm in the pursuit of Natural History, wherever opportunity offered, formed the subject of much admiration, and not a little good-humoured banter, among his fellow-officers in the various ships in which he served. His commissions abroad included prolonged voyages to the Pacific, Australian, and Mediterranean stations, with shorter visits to South Africa and China. From the date of his entry into the Navy his journals were continued without a break and within less than two years of his decease, and these must embody an immense amount of valuable and interesting entomological information. Most of his attention was devoted to the Lepidoptera, and of these he made large collections on each of his voyages, though other Orders of Insects were not neglected.

The last years of his active service were spent in the Harwich district, and on his retirement he continued to reside at Dovercourt, Essex, in a highly productive and interesting entomological locality, where he continued to work with characteristic energy and great success until well past his eightieth year. A new and very distinct Noctuid Moth, *Leucania favicolor* Barrett, was discovered at Dovercourt in 1886, and was afterwards taken and distributed freely by him; and he was also the first to indicate the interesting "Plume-Moth," *Adkinia graphodactyla* Treitschke, as a British species, from specimens which he bred from larvæ found in East Dorset in 1906. Mathew excelled in rearing Lepidoptera from their early stages, and several of his local "strains" were well known among Entomologists. He also possessed considerable powers as a water-colour painter, especially in the delineation of his favourite butterflies.

His health broke down in 1925, and for many months before his death he was confined to his bed; and he passed away peacefully on the eve of his eighty-sixth birthday.

[J. J. WALKER.]

JOHN CLARK NEWSHAM, Principal of the Monmouthshire Agricultural Institution at Usk, who died on the 30th October, 1927, had a distinguished career as an agricultural teacher and

organizer. In 1900 he became the Principal of one of the first agricultural institutes in this country, the Hampshire Institute, then at Old Basing, which for many years did splendid work under the control of his inspiring personality. He was at the same time County Agricultural Adviser for Hampshire, and, largely on account of his attainments in the theory and practice of agriculture, he soon won the confidence of the farming community.

In 1914 Newsham removed to Usk and undertook the task of organizing the newly established Monmouthshire Institute as its first Principal. Faced with the difficulties of the War years from the very beginning of his labours, his abilities, his temperament, and his breadth of vision were essential factors in his success. In 1923 he also became County Agriculture Adviser for Monmouthshire, and to his energy in this capacity is due the development of the many activities in agricultural education which now exist throughout the country.

While his organizing work at Usk was in many ways unique, his literary abilities won him a great reputation as an authoritative writer on agricultural affairs, and some of his works, such as 'Agriculture, Theoretical and Practical,' 'Agricultural Arithmetic,' and 'Dairy Farming,' have become standard text-books.

His death has removed one of the most active agriculturists in the country. The many hundreds of students who passed under his tuition both in Hampshire and at Usk will deeply regret his kind and charming personality, but his loss is one which will not only be felt in his own county, but in the wider sphere of agricultural education generally.

Mr. Newsham leaves a widow and one daughter. [R. C. M.]

WILLIAM CHARLES FRANK NEWTON was born at Saham Toney, Thetford, Norfolk, on February 16th, 1895. He was educated at Thetford Grammar School and Birkbeck College, University of London. Just of an age for war service, he was drawn into the turmoil of the Great War, and served in the Royal Engineers, Special Brigade, Q Company, from 1915 to 1918, receiving a Commission in the Royal Garrison Artillery in 1919. On demobilisation he continued his studies at Birkbeck College, and obtained the degree of B.Sc. with first-class honours in Botany in 1921.

Assisted by a grant from the Department of Industrial and Scientific Research, he began a cytological investigation into the nature and extent of the paired association of somatic chromosomes in the nuclear divisions of *Galtonia caudicans* and *G. princeps*. This research was commenced in the laboratory of the Birkbeck College and completed at the John Innes Horticultural Institution. The results appeared in a paper published in the 'Annals of Botany,' vol. xxxviii. 1924, under the title "Studies in Somatic Chromosomes.—I."

In 1922 the late Dr. W. Bateson invited him to join the Staff

of the John Innes Institution at Merton, Surrey, as cytologist. Newton accepted the invitation and ardently pursued his cytological researches, working principally upon the fine collection of *Tulipa* species which the late W. R. Dykes had brought together at the Institution. He read a paper entitled "Chromosome Studies in *Tulipa* and some related Genera" before the Society on the 2nd April, 1925. The paper appeared in the 'Journal' of the Society, Botany, vol. xlvii, 1927. Among other points he dealt with the chromosome number and form of a wide range of *Tulipa* species, and, so far, it was incidental to an attempt to find a basis of classification. He was also occupied with an investigation of the subspecific crosses in *Silene Otites* resulting in the production of unequal sex ratios accompanied by variegation. In collaboration with Miss C. Pellew, a paper was read before the British Association (Section K) Meeting at Oxford, 1926, on "*Primula kewensis* and its Derivatives." Much other work was always in hand, including the genetics and cytology of *Geranium* species, with special reference to the inheritance of sex and variegation, and the inheritance of flower-colour in *Papaver*. He was also responsible for the cytological observations and discussion in a joint paper with B. H. Buxton on "Hybrids of *Digitalis ambigua* and *D. purpurea*" (Journ. Genetics, vol. xix, 1928).

At the Institution cytology was the handmaiden of genetics, and in his branch of research Newton's services were invaluable; his opinion upon methods of preparation and the interpretation of nuclear figures was continually sought and freely given.

During the summer of 1926 his health began to fail, and medical advice was sought. Ill health continued, and a thorough examination revealed the cause which had hitherto been unsuspected. In August a severe operation was borne with great fortitude and determined spirit. A recovery was made, and with his wife he wintered in Algeria, returning home in April 1927. Throughout the summer he continued to work in the laboratory and field. After a short holiday he returned, suffering acutely, and later it became evident that the hope of a final recovery would not be realised. He passed away at Merton Park on December 22nd, 1927.

Newton was elected a Fellow of the Society on March 5th, 1925. He married Lily, daughter of G. Batten, of Pensford, Somerset, on September 2nd, 1925. [E. J. COLLINS.]

CAMPBELL PATRICK OGILVIE died on May 22, 1927, aged 73. He was elected a Fellow on March 21, 1878, and for many years whenever in London attended our meetings. His particular interest in early life was in the microscopical examination of the rocks of East Anglia, but while taking part in discussions he seldom contributed to the literature of science. He was concerned with every phase of the biology of East Anglia, and was at one time honorary curator of the Yarmouth Museum ;

he was a prominent supporter of the Volunteer movement and received the V.D. many years ago.

Mr. Ogilvie was a man of great tact and charm; he brought to conversation a wealth of experience gained in many countries. Happily as a boy he was educated in science, then itself a single section in education, and he grew with its growth and absorbed its principles and aims. He had great powers of observation, and a quite wonderful way of applying science in practical life—this unconscious on his part. In Canada, with members of the British Association, he discussed the development of the fisheries of the Province of Winnipeg, and propounded plans for trawler developments around Queen Charlotte Islands and off Greenland, a subject further considered at Cambridge in the following year. He also on an earlier visit suggested the growing of timber belt refuges for cattle in Canada to provide shade areas free from biting flies. He based this on his observations on the lands of the Santa Fé Co. of the Argentine, of which he was for many years the Chairman, and which now forms a basal element in the Forestal Co. He was also prominent in the development of the Central Argentine Railway and many other enterprises employing British capital in the Argentine, in Canada, in Russia, and other places; as for several years Deputy Chairman, he was one of the builders of the Powell Duffryn Co. [J. S. G.]

EDWARD AUGUSTUS PETHERICK, who died on September 17th, 1917, was born in England in 1847, and arrived in Victoria with his parents in 1852. For the greater part of his life he was connected with the book-selling and publishing business, both in Melbourne and in London, and he early developed a taste for collecting publications relating to Australia, which resulted in the formation of the valuable library of Australiana presented by him to the Government of the Commonwealth in 1909. In order that Mr. Petherick might still be associated with the collection which had been his life's work, he received the appointment of Commonwealth Archivist, which position he retained up to the time of his death. He was one of the founders of the Historical Society of Victoria, and contributed to the pages of the 'Victorian Historical Magazine' some sections of a bibliography of the State based upon the collection above referred to. [A. W. G.]

REGINALD WILLIAM PHILLIPS was born at Talgarth, Breconshire, on October 15th, 1854, and died at Leominster on December 2nd, 1926. He took the two years' course of training at Bangor Normal College, and was certificated as elementary school teacher in December 1874. Though appointed headmaster of a school at Ferndale in 1875, he soon returned to his old College as lecturer. In 1881 he resigned that post and entered St. John's College, Cambridge, where he studied for the Natural Sciences Tripos, taking first-class honours in 1884, and being awarded a Foundation Scholarship by his College; at the same time he passed the London B.Sc. Examination. When, in the same year,

the North Wales University College was established at Bangor, Phillips was appointed Lecturer in Biology; later on he became Professor of Botany, and occupied the Chair until 1922. He also gave extra-mural courses of lectures in local centres with great success. In 1898 he obtained his London D.Sc. degree for a thesis on Algæ. He was intensely interested in the study of seaweeds, and more particularly in the morphology of the Floridææ. In 1895-96 he contributed to the 'Annals of Botany' some important papers "On the Development of the Cystocarp in Rhodomelaceæ" and a similar account of the Rhodymeniales in 1897-98. He supplied long and valuable articles on the Algæ to the supplement of the tenth edition of the 'Encyclopædia Britannica' (1902) and to the eleventh edition (1910). And now for several years his opportunities for research work became much restricted owing to the pressure of professorial duties and of administrative work; for he was deeply concerned in the establishment and welfare of the Welsh University, as well as in the promotion of an adequate system of secondary education in Wales to provide a flow of pupils to the University. He served for years as Vice-Chairman of the Governors of the Bangor Secondary Schools, and was a member of the Merionethshire Education Committee. Further, he was a magistrate of the county of Carnarvon, and, during the War, was chairman of the local Tribunal. It was not till he resigned his Chair in October 1922 that he was able to return to his algological studies, and to attack some of the problems which he had noted down as to be investigated when opportunity should permit. In 1924 he published two papers, in the 'New Phytologist' and the 'Annals of Botany' respectively—"The Ceramidium of *Polysiphonia*" and "On the Structure of *Spyridia filamentosa*." In the following year three more of his papers appeared—"On the Origin of the Cystocarp in the Genus *Gracilaria*" ('Annals of Botany'); "On the Genera *Phyllophora*, *Gymnogongrus*, and *Ahnfeldtia*, and their Parasites" ('New Phytologist'); "On Vascular Pseudopodia in *Callithamnion* sp." ('Revue Algologique'). His last publication was "On the Form of the Protoplast in Cells of the Genus *Ceramium* and those of *Dasya coccinea*"; it appeared in the 'New Phytologist' of 1926. He had in his last years been troubled by recurrent attacks of illness, and in December of that year he passed away.

Phillips was endowed with a clear head and thoughtful mind, and was an alert observer and always keen to discover the right explanation of nature's problems.

He was granted the degree of LL.D. by the University of Wales, and became a Fellow of the Linnean Society on December 18th, 1890.

A fuller notice of Phillips was contributed by his friend, Mr. J. Lloyd Williams, to the 'Journal of Botany,' 1927, pp. 80-83, from which source the above account has been mainly derived.

[A. G.]

Sir ARTHUR EVERETT SHIPLEY was the second son of Alexander Shipley, of the Hall, Datchet, who died in 1896. He was born at Walton-on-Thames on March 10, 1861, and died at the Master's Lodge of Christ's College, Cambridge, on September 22, 1927. His health had for some time been failing, but it was hoped that a visit to Trinidad undertaken at the beginning of 1927 might re-establish it. This hope was not realized, and, after his return early in March, his condition continued to give his friends anxiety. This was accentuated during Easter week by an attack which for some 48 hours seemed likely to prove fatal. He made an unexpected and really wonderful recovery, and for a considerable part of May and June was able to lead an active life, attending to business and taking daily walks, both in the College grounds and in the town. The improvement did not continue, however, and although he was able to spend three weeks at Folkestone towards the end of July he was going downhill, with fluctuations, throughout the summer. The final illness began to show itself towards the end of August. Before his death he was contemplating a short account of the influence of Biological Science on the spread of Colonisation, to have been published in the 'Cambridge History of the British Empire,' of which Dr. J. Holland Rose is one of the editors; but this essay does not appear to have been begun.

Arthur Shipley was one of several children, of whom two sisters survive—Mrs. A. Hutchinson, wife of the present Professor of Mineralogy at Cambridge and Master of Pembroke College, and another who married Dr. H. M. Stewart, a well-known medical practitioner in Dulwich and Senior Surgeon of the South-Eastern Hospital for Children. His elder brother, Sir William Shipley (died 1922), was three times Mayor of Windsor, and his younger brother Reginald (died 1924) went to the Boer War as a captain of the City Imperial Volunteers, served as colonel in the Great War, and received the honour of C.M.G.

Sir Arthur Shipley was a Fellow of the Linnean Society from 1888 to 1894. He was re-elected on December 15, 1904, and served on the Council of the Society 1906-1907 and 1915-1918, the latter period coinciding with his appointment as a Vice-President.

In childhood Shipley was markedly delicate, having commenced life as an abnormally small infant. He developed rather late, and is said to have taken no real interest in learning until he entered University College School, London, in 1877. Like many other naturalists, he commenced his scientific career as a medical student, and spent a year at St. Bartholomew's Hospital. In 1880 he entered Christ's College, Cambridge, in the Michaelmas Term. He obtained a First Class in both parts of the Natural Sciences Tripos, Part I. in 1882 and Part II. in 1884, having been engaged for several months between these two examinations in research work at the Zoological Station at Naples, a place for which he retained a strong affection. He was elected to a Fellowship at

Christ's in 1887, and became Master of the College in 1910. In this capacity he served as Vice-Chancellor of the University from 1917 to 1919. He had been appointed Demonstrator of Comparative Anatomy in the University in 1885, Lecturer on Advanced Morphology of the Invertebrata in 1894, and Reader in Zoology in 1908; and for many years from 1891 he had been Secretary to the Museums and Lecture Rooms Syndicate, an important position which made him practically the business manager of the numerous Museums, Laboratories, and other buildings which came under the control of that body. From the time of his entry as a freshman in 1880 till his death he resided in Cambridge, but he travelled extensively and had probably lost count of the number of times he had crossed the Atlantic, principally in visits to the United States, where he had many close personal friends. He was elected into the Royal Society in 1904, serving on its Council from 1909 to 1911, and he was a member of many other learned societies. He was Chairman of the Council of the Marine Biological Association, Treasurer of the Research Defence Society, and a member of the Central Medical War Committee and of the Managing Committee of the Imperial Bureau of Entomology. His scientific distinction, principally as a parasitologist, was recognized by his election as Foreign Member of the American Association of Economic Entomologists and of the Helminthological Society of Washington, and Honorary Member of the Société Royale Zoologique et Malacologique de Belgique and of the Yorkshire Philosophical Society. He was a Trustee of the Hunterian, Tancred, and Beit Foundations, a member of the Royal Commissions on the Civil Service, Trinity College, Dublin, and the Importation of Store Cattle; and of the Departmental Enquiry into Grouse Disease. He received the Honorary Degrees of D.Sc. Princeton, LL.D. Michigan, and M.Sc. Drexel Institute, Philadelphia. His public services were recognized in this country when he was selected for the honour of G.B.E. in 1920.

It follows from this recital that Shipley's career was a many-sided one. He was in the first instance a competent zoologist and a successful researcher and teacher. He had great gifts as a popular writer, who could expound the results of Biological research in an intelligible form, made more attractive by numerous touches of effective humour. From early days he realized the immense importance of Biological knowledge in its practical bearings on Agriculture, health and disease; and a large proportion of his public work was devoted to the application of this knowledge. He did notable service to the country during the Great War.

Shipley and I came up to Cambridge at the same time, in October 1880. We were the companions of specially brilliant students, many of whom were destined to achieve marked distinction. Among these may be mentioned Adami, Bateson, Chree, Fitzpatrick, J. R. Green, Harker, Head, Sherrington, Threlfall, and D'Arcy Thompson, besides others, such as Sorley,

Adam and Whitehead, in subjects outside the range of the Natural Sciences Tripos. The stimulating effect of this personal environment was increased by the enthusiasm of our teachers, who successfully inculcated in us the belief that knowledge is good for its own sake. The study of Science had quite recently begun to make great strides in Cambridge, although we were not contemporary with the commencement of the modern movement, largely due to Adam Sedgwick and Henslow. The list of University Professors and others working for science was, however, a notable one. Liveing, Humphry, and Michael Foster had been mainly instrumental in establishing the claims of natural science to an honoured place in the University. Lord Rayleigh was Cavendish Professor, and Zoology was represented by Alfred Newton, J. W. Clark, F. M. Balfour, and Adam Sedgwick the younger. Vines, a Fellow of Shipley's College, was engaged in teaching Botany on modern lines. Although I cannot speak too highly of the friendship and scientific assistance we received from Newton and Clark, the influence of Frank Balfour must be mentioned as the outstanding zoological feature of our student days. The effect produced in Cambridge by the news of his death in an Alpine accident on Mont Blanc, in July 1882, may be estimated by the records Shipley has left in two of his books ('J. W. Clark,' p. 136 and 'Cambridge Cameos,' p. 162). Balfour's personal qualities had endeared him to his pupils in a way few teachers are beloved. His great work on Comparative Embryology had just been published; and Shipley, like others of his pupils, early commenced research work in this field. Before taking Part II. of his Tripos he had produced an interesting paper on the structure and development of the Brachiopoda (Mitth. Zool. Stat. Neapel, iv, p. 494), and in January 1887 he published a valuable account of the development of the River Lamprey (Quart. J. Micr. Sci. xxvii, p. 325). The study of morphology had recently received a special stimulus by the invention, in the Cambridge Laboratory, of a new method of cutting and mounting serial microscopic sections. By means of the automatic microtome of Caldwell and Threlfall, the first instrument of its kind, it became easy to cut sections in continuous ribbons, and to fasten them to slides in such a way that every section occupied its proper place in the series. The study of embryology and anatomy, particularly of many of the groups of Invertebrates, was immensely facilitated by this simple device, an entirely new departure in methods which was fully utilized by Shipley and his contemporaries. He has himself expressed surprise ('Cambridge Cameos,' pp. 143, 162) that embryology and morphology constituted so large a proportion of the research carried on at the end of the last century under the special influence of Darwin's teaching, itself the result of study along widely different lines.

Shipley did not, however, follow up his earlier interests, except by writing articles on Brachiopoda in 'The Cambridge Natural History' (1895) and the *Encyclopædia Britannica* (1902). He

soon turned his attention to the Gephyrea, on which he published his first important memoir in 1890 ("On *Phymosoma varians*," Quart. J. Mier. Sci. xxxi. p. 1). This was followed by several other substantial papers on the same group, treated partly on morphological and partly on systematic lines; including descriptions of the species collected by various expeditions. The publication of the ten volumes of 'The Cambridge Natural History' (1895-1909), of which he was joint editor, occupied much of his time for some years, but he was meanwhile establishing his reputation as an authority on parasitic worms, on which he published at least 40-50 papers. The consideration of the numerous practical questions arising from the investigation of parasites was no doubt largely instrumental in leading him to a more general study of the economic aspects of Zoology. As early as 1887, however, he had been sent by the Colonial Office on a mission to investigate a plant disease in the Bermudas, and in 1889 he had published a note on beetles destructive to rice-crops in Burma. As years passed he became increasingly interested in the practical applications of Biology, a subject which remained as his most enduring interest. He performed a valuable service by participating in original work of this nature and by emphasizing, in popular writings, the enormous importance of a knowledge of Biology to mankind. Although not by nature or inclination a systematic Entomologist, much of his later work was concerned with Insects and Arachnids. During the War, for instance, he published two very attractively written booklets, mainly on these groups, 'The Minor Horrors of War' (1915) and 'More Minor Horrors' (1916), which were widely read and forcibly brought home to those who were not Zoologists the lesson that a study of Insects is essential to success in war as in peace. He was consulted on the establishment, by the Colonial Office, of the Imperial Bureau of Entomology, originally founded, under another name, in 1909, with Lord Cromer as its first Chairman; and he served as a member of the Honorary Committee of Management from the beginning until his death. At a later period Lord Milner asked his advice with regard to the foundation of a College of Agriculture in the Tropics, and shortly afterwards (in 1919) he appointed a Tropical Agricultural College Committee, with Shipley as its Chairman. The project took definite shape in 1921, when the West Indian College of Tropical Agriculture was established, with a Governing Body of which Shipley was Chairman. He continued to hold this position until his death, the College having meanwhile become the Imperial College of Tropical Agriculture. In 1924 he visited Trinidad, where the College has been erected, to attend the ceremony of laying the foundation stone, and in the course of this journey he went also to Jamaica, New York, and New Orleans in the interests of the College. He re-visited Trinidad early in 1927, but, as explained above, the voyage was not successful in improving the condition of his health, which had become unsatisfactory. The value of his

work for the College is indicated by a Resolution of the Governing Body which was passed immediately after his death, recording their deep sense of the irreparable public and personal loss sustained by the College, the Governors, and the Staff.

Shipley was at all times keenly interested in such subjects as Malaria and Yellow Fever, which are carried by Dipterous Insects, and the Hook-worm disease of miners, due to a Nematode parasite: each of these diseases being responsible for an enormous toll of human life and for an almost equally important diminution of human vigour and efficiency.

In 1893 Shipley produced his 'Zoology of the Invertebrata,' a text-book which has been largely used by students; and he collaborated with Prof. E. W. MacBride in writing another text-book ('Zoology,' 1901), a work which has had an equally successful career. He had previously been associated with Dr. Schönland and Prof. Poulton in translating and issuing an English edition of Weismann's researches, entitled 'Essays upon Heredity,' a book which greatly assisted in familiarising English readers with Weismann's results. He was editor of the Pitt Press Natural Science Biological Series, and, for a time, of the 'Fauna of British India' series, and co-editor of 'Parasitology' and of the 'Journal of Economic Biology.' He was perhaps at his best as a popular exponent of Zoology, in articles he wrote for 'The Times' and other papers, and in various books, of which the earliest seems to have been 'Pearls and Parasites' (1908). "J," A Memoir of John Willis Clark' (1913) is a skilfully written account of a singularly attractive personality, containing much interesting information with regard to Cambridge during the Nineteenth Century, including its earlier half, when conditions were very different from those existing at present, together with a valuable record of the growth of the Natural Science School. During the Great War and while Vice-Chancellor of the University, Shipley was a member of the British University Mission, which was sent out by the Foreign Office on the invitation of the Council of Defence at Washington. In this capacity he made a very extensive tour in the United States, visiting the principal Universities and helping to interest Americans in the British share in the War. An attractive sketch of this visit, during which Peace was declared, was published as 'The Voyage of a Vice-Chancellor' (1919). His small book, entitled 'Life' (1923), was published in response to an invitation by the Cambridge University Press "to write a book which would make students of Elementary Biology think." The effort may be described as eminently successful. The book is divided into a series of chapters illustrating the various manifestations of life by well-chosen instances, and it gives much information which is not at the disposal of every professed Biologist. As in his other popular writings, the style is attractive, lightened by well-placed humour which does not detract from the dignity of the subject. It is interesting to note that he closes on a note of optimism, and concludes that "the world is a better, a cleaner,

and a kindlier place to live in than it was in the middle of the last century." His 'Cambridge Cameos' (1924) includes a sketch of the early history of Cambridge and much other interesting matter. He records the discovery of the first proclamation of Henry VIII. in certain paper taken down from the ceiling of rooms in the Lodge at Christ's, during the repairs and reconstruction which were undertaken on his becoming Master. The essay on "The Hunting of the Yale" is a characteristic example of his success in dealing with a subject which is partly Zoological. The appreciation of E. A. Wilson, who was one of those who lost their lives in Scott's last Antarctic Expedition, brings out not only the charm of the man he commemorates, but also his own capacity to do justice to the good qualities of a friend. In 'Islands' (1924) he describes some of his travels abroad, giving information about the Imperial College of Agriculture at Trinidad and other places he had visited. Among the more interesting records in this book is a description (p. 95) of a visit he paid to Metchnikoff, at Messina, in 1883, the year of the discovery by that great naturalist of the rôle played by phagocytes in health and disease. The personal results of that discovery are recorded in Metchnikoff's own words: "A Zoologist until then, I suddenly became a pathologist."

No memoir of Shipley would be complete if it did not emphasize the value of his public work. He served on innumerable Committees, Councils, and Government Commissions, and he was Vice-Chancellor of the University during the two critical concluding years of the War. At this time he worked unceasingly, in addition to his more routine duties, in making the resources of Cambridge available for employment to the advantage of the country. He was concerned with the organisation of hospitals, with making Cambridge a training place for cadets and for staff officers on leave, and he placed his extensive knowledge of parasites at the disposal of the Government. His hospitality to wounded officers was unending, and he had a constant succession of convalescents living with him at the Lodge, sharing his meals and conversing with him during the evenings, when he might well have found reasons for not showing this kindness by pleading the exacting nature of his ordinary duties. He took great interest in the courses of study for Naval Officers which were instituted in Cambridge after the War.

Several other services he performed for the University should also be mentioned. He was specially interested in the Appointments Board, a body which has done valuable work in finding careers for young graduates. It may be worth while to notice also the action he took in arranging for the annual publication of 'The Cambridge Pocket Diary,' which differs from most of its kind by beginning at the end of September, just before the commencement of the Academic Year, ending at the conclusion of the following Calendar Year. This is a most convenient form for those who are concerned with Universities

and learned Societies, but I think I am right in stating that the idea originated in Oxford, shortly before the first Cambridge Diary appeared. Shipley was responsible for selecting, as the motto of the Diary, the apposite lines, taken from J. K. Stephen:—

“ Years die in July and are dead till September :
By the first of October the New Year's born :
It's a sturdy infant in mid-December,
And reaches its prime some April morn :
Hot and weary in June, it must perish soon,
It is working too hard : it will break : but *here*
Is the Dawn of the Year.”

The wide range of Shipley's interests is further illustrated by the fact that in 1917 he presided at a meeting, held in Christ's Lodge, which resulted in the foundation of the Cambridge University Anglo-Spanish Society (now the C.U. Spanish Society) and in his election as Chairman. He specially exerted himself to assist the Society after the establishment of the Readership in Spanish in October 1919. The Spanish Ambassador, Señor Merry del Val, with his wife, subsequently stayed at the Lodge, on Shipley's invitation, and addressed the students at a most successful meeting. At a later period the Chilean Minister, Señor Agustín Edwards, visited Cambridge in similar circumstances, and afterwards became a frequent visitor at the Lodge. These visits stimulated interest in the study of Spanish and led to a large increase in membership of the Society, principally among undergraduates. Shipley took the practical method of keeping up this interest by frequently receiving the members at pleasant gatherings in his study.

Shipley had an unusually wide circle of friends among persons in all degrees of society. He had special pleasure in giving small dinner parties, which he considered more conducive to the true intimacy of friendship than the larger and more formal parties of this nature which were at one time general in Cambridge. He entertained regularly on Sundays at luncheons, and he welcomed men of all ranks and ages who chose to visit him at his informal receptions on Sunday evenings. His knowledge of the world rendered his counsel particularly valuable to his College and University. He was respected by all as a man who consistently maintained the highest standard of public and private duty, and in the midst of responsibilities which might well have absorbed all his attention he was invariably ready to give his time to the performance of acts of kindness. May I add that he was the earliest of my Cambridge scientific friends, and that, as his collaborator for many years in matters in which we were closely associated, I had the best opportunities possible of appreciating his ability, his versatility, his industry, and above all his unselfish devotion to duty and kindness of heart.

In writing this memoir I have made special use of the notice

in 'The Times' of September 23. I have further to acknowledge the assistance which has been kindly given me by Sir Arthur's sister, Mrs. A. Hutchinson, by her husband, Professor Hutchinson, F.R.S., Master of Pembroke, and by Mr. Algernon Aspinall, C.M.G. [SIDNEY F. HARMER.]

WILLIAM ANDREW SHOOLBRED was born at Wolverhampton on March 11, 1882, and was educated at Wolverhampton, Edinburgh University, and London University. He was house surgeon at St. Bartholomew's Hospital, and thence he went to Chepstow in 1878-9 as assistant to Dr. White, whom he later succeeded in the practice.

He published a Flora of Chepstow and the surrounding district in 1920.

Dr. Shoolbred was a very old friend of my father, and they made botanical excursions together almost every year, from 1894 until 1916, in Scotland or Ireland.

Dr. Shoolbred was especially interested in the trees and shrubs of the British Isles, and in Rubi and Hieracia botanically, and in Rock Plants and Primulas horticulturally. He had a wonderful garden full of rare plants looking down over the Castle Dell to the River Wye.

He also carried on a correspondence with a number of British botanists.

He died at his home, St. Ann's, Chepstow, on January 25, 1928. [P. M. MARSHALL.]

EDGAR RAVENSWOOD WAITE was born at Leeds in 1866. In 1888 he was appointed Sub-Curator, and in 1891 Curator, of the Leeds Museum. In 1892 he was selected as Assistant in Zoology at the Australian Museum, Sydney, taking charge of the vertebrates, though he soon became specially interested in reptiles and fish. He accompanied the s.s. 'Thetis' on its trawling cruises off the New South Wales coast, an enormous quantity of material being collected and distributed to various workers for examination and report.

In 1906 he succeeded Capt. Hutton as Curator of the Canterbury Museum, Christchurch, New Zealand. During his eight years' residence in that Dominion he accompanied scientific expeditions to the Southern Islands of N.Z., the Subantarctic Islands of N.Z., and Macquarie Island (with Mawson's Antarctic Expedition in the 'Aurora' in 1912, and again in 1913 with the relief expedition in the 'Tutanekai').

In 1914 he was appointed Director of the South Australian Museum, Adelaide, a position which he occupied until his death in January 1928. He took part in trawling cruises in the Great Australian Bight, and made collecting trips to Central Australia, New Guinea, New Britain, and New Ireland, as well as to various islands (Nuyts Archipelago and Investigator Group) in the Australian Bight. He visited Europe and America in 1926.

His health became undermined by malaria contracted in New Guinea in 1918, and did not benefit materially by his world tour. Whilst on a visit to Hobart to take part in the meeting of the Australasian Association for the Advancement of Science (January 1928) he contracted typhoid and died there.

He was a capable and energetic museum administrator, and found time to carry out scientific work, about 140 papers having been published by him. His most important contributions have been to Ichthyology, viz. the reports on the collections made by the 'Thetis,' the various New Zealand expeditions, and the Australian Antarctic Expedition. He published a list of New South Wales fishes, and also an illustrated catalogue and a handbook of the South Australian fishes, while a handbook on South Australian amphibia and reptiles was practically completed, and will be published posthumously.

He inaugurated the Records of the Canterbury Museum and of the South Australian Museum, and edited the series of Natural History Handbooks now being issued by the Adelaide Branch of the British Science Guild. He founded the Aquarium Society of South Australia, served on the Flora and Fauna Board which controls the national reserve at Flinder's Chase, Kangaroo Island, and was an active member and councillor of various scientific societies. He was elected a Fellow of the Linnean Society of London in 1890, and a C.M.Z.S. in 1922.

[T. HARVEY JOHNSTON.]

BENEFACTIONS.

LIST in accordance with *Bye-Laws, Chap. XVII. Sect. 1, of all Donations of the amount or value of Twenty pounds and upwards, received during the past Twenty years.*

1909.

The Trustees of the Percy Sladen Memorial Fund: Second grant towards publication of Mr. Stanley Gardiner's *Researches in the Indian Ocean in H.M.S. 'Sealark,'* £200.

Prof. James William Helenus Trail, F.R.S., F.L.S.: Gift of £100 in Trust, to encourage Research on the Nature of Proto-plasm.

1910.

Royal Society: Grant towards Dr. G. H. Fowler's paper on *Biscayan Ostracoda*, £50.

Sir Joseph Hooker: Gold watch-chain worn by Robert Brown, and seal with portrait of Carl von Linné by James Tassie.

Prof. J. S. Gardiner: Payment in aid of illustrations, £35 0s. 6d.

Sir Frank Crisp: Donation in Trust for Microscopical Research, £200.

The Trustees of the Percy Sladen Memorial Fund: Third grant towards publication of Prof. Stanley Gardiner's *Researches in the Indian Ocean*, £200. (For third volume.)

1911.

The Trustees of the Percy Sladen Memorial Fund: Second Donation towards the publication of the third volume on *the Indian Ocean Researches*, £70.

The same: First Donation towards the fourth volume, £130.

1912.

The Indian Government: Contribution towards the illustration of Mr. E. P. Stebbing's paper on *Himalayan Chermes*, £46 15s. 2d.

The late Mr. Francis Tagart, £500 free of Legacy Duty.

The late Sir Joseph Dalton Hooker, O.M., G.C.S.I., £100 free of Legacy Duty.

The Trustees of the Percy Sladen Memorial Fund: Second Donation towards the publication of the fourth volume on the Indian Ocean Researches, £140.

The same: First Donation towards the fifth volume, £60.

1913.

Royal Society: Grant towards Dr. R. R. Gates's paper on Mutating *Oenotheras*, £60.

Sir Frank Crisp, Bt.: Wallichian Cabinets, £50.

The Trustees of the Percy Sladen Memorial Fund: Second Donation towards the publication of the fifth volume, £200.

1914.

Royal Society: Grant towards Miss Gibbs's paper on the Flora of British North Borneo, £50.

Miss Foot: Cost of illustration of her paper on *Euschistus*.

The Trustees of the Percy Sladen Memorial Fund: Third Donation towards the fifth volume, £10.

The same: First Donation towards the sixth volume, £190.

1915.

The Trustees of the Percy Sladen Memorial Fund: Second Donation towards the sixth volume, £80.

Miss Foot: Cost of second paper on *Euschistus*, £32 10s.

Royal Society: Donations towards the cost of a paper by Mrs. Arber, D.Sc., £40.

The same: towards paper on Utakwa River plants by Mr. H. N. Ridley, C.M.G., F.R.S., £50.

Miss Marietta Pallis: Instalment of cost of her paper on *Plav*, £30.

Thomas Henry Riches, Esq.: Dr. A. R. Wallace's library on Natural History.

Sir Frank Crisp, Bt.: New shelving for Wallace's Volumes.

1916.

Mr. E. Heron-Allen: Contribution to cost of paper on Foraminifera of N.W. Scotland, £44.

Messrs. H. Takeda and C. West: Contribution towards the illustration of their paper, £40.

Royal Society: Contribution towards the illustration of two papers by Prof. Dendy, £40.

The same: Contribution towards Mr. Swynnerton's paper on Form and Colouring, £70.

The High Commission for the Union of South Africa, per Dr. J. D. F. Gilchrist, for the illustration of his paper on *Jasus Lalandii*, £30.

Miss Marietta Pallis: Balance of cost of her paper on Plav, £90 16s. 6d.

Sir Frank Crisp, Bt.: Phototyped copy of Dioscorides from the 'Codex Aniciæ Julianæ' at Vienna.

1917.

British Ornithologists' Union, etc.: Contribution towards cost of Mr. H. N. Ridley's paper, £20.

The Royal Society: Second contribution towards the printing of Mr. C. F. M. Swynnerton's paper on Form and Colouring, £75.

Sir Frank Crisp, Bt.: 'Lindenia,' Ghent, 1891-1901. 17 vols. sm. fol.

1919.

Dr. B. Daydon Jackson: MS. index to Linnean Society's Journal, Botany, vols. xxi.-xl. (1884-1912) and the Botanic entries in the 'Proceedings' for the same period.

1920.

The Royal Society: Third contribution towards the printing of Mr. C. F. M. Swynnerton's paper as above, £50.

The High Commission for the Union of South Africa, for the printing of Dr. J. D. F. Gilchrist's paper on *Jasus Lalandii*, Part II., £60.

1921.

The Percy Sladen Memorial Fund: Additional Grant in aid of publication of 'Transactions,' 2nd ser., Zoology, vol. xvii. part 4, £72 10s.

The same: Grant in aid of publication of four papers on the Houtman Abrolhos Islands, £100.

The Royal Society: Donation in aid of papers by Mr. N. E. Brown and Mr. S. L. Moore, £90.

Dr. W. Rushton Parker: Donation of a large series of portraits of Naturalists and Persons after whom Genera have been named, and work on rearrangement and annotation of the entire collection.

Prof. C. S. Sargent, F.M.L.S.: Eight volumes issued by the Arnold Arboretum including "The Bradley Bibliography."

Dr. B. Daydon Jackson: MS. Catalogue of each sheet in the Linnean Herbarium; bound in two volumes folio.

1922.

The late Sir Joseph Hooker: Donation of his Medals and Decorations. (Reversion to Linnean Society on Lady Hooker's decease.)

Anonymous donation in aid of publication of the late Dr. E. A. Newell Arber's paper, entitled "Critical Studies of Coal-Measure Plant-impressions," £60.

The Percy Sladen Memorial Fund: Cost of printing and illustrating 'Transactions,' 2nd. ser., Zoology, vol. xviii. pt. i.

1923.

Dr. W. Rushton Parker: (1) Donation of Oxford New English Dictionary; vols. i.-ix., vol. x. in parts, 4to, 1888-1923→
(2) Encyclopædia Britannica; ed. XI. Cambridge, 1920-22. 32 vols. 4to.

E. Heron-Allen, Esq., F.R.S.: Contribution of £25 towards the cost of paper on the Foraminifera of Lord Howe Island.

1924.

The Percy Sladen Memorial Fund: Cost of printing and illustrating 'Transactions,' 2nd. ser., Zoology, vol. xviii. pt. ii.

1925.

An Anonymous Donor: New Presidential Chair, emblazoned with the Arms of the Society.

1926.

Mr. A. D. Michael: A large number of Books and Pamphlets from his Library.

The late Mr. A. O. Walker: £200 free of Legacy Duty.

An Anonymous Donor: £100 to establish a Fellowship in memory of the late Prof. E. A. Minchin, F.R.S., Sec.L.S.

The Royal Society: Donation in aid of publication of Mr. G. P. Farran's paper on Biscayan Plankton.—Part 14. The Copepoda, £60.

The late Mr. Frank Morey: £100 free of Legacy Duty.

The late Mr. George Lewis: Books and pamphlets on Entomological subjects.

Capt. E. G. Spencer-Churchill: A copy of a collotype reproduction of 'The herbal of Apuleius Barbarus . . . (MS. Bodley 130).'

The Percy Sladen Memorial Fund : Cost of printing and illustrating 'Transactions,' 2nd ser., Zoology, vol. xix. pt. i.

1927.

The late Mrs. Mary Anne Stebbing : £100 less Legacy Duty.

1928.

Carnegie United Kingdom Trust : £666 13s. 4d. for purchase of books.

The Royal Society : £160 (£85 in aid of the publication of Dr. G. Enderlein's paper on 'Die Copeognathen der Seychellen,' £75 in aid of Mr. C. V. B. Marquand's paper on "The Botanical Collections made by Capt. F. Kingdon Ward in the Eastern Himalaya and Tibet in 1924-25").

TREASURER'S ACCOUNTS FOR THE

(Presented at the Anniversary

Receipts and Payments of the Linnean Society

General

	RECEIPTS.	£	s.	d.	£	s.	d.
To Balance at 1st May, 1927		248	0	7			
Do. deposits, Fellows' postal account		62	12	7			
„ Cash in hand		7	14	0			
					318	7	2
„ Admission Fees					56	0	0
„ Arrears of Annual Contributions.....		40	10	0			
„ Annual Contributions for year.....		2412	10	10			
Do. in advance.....		170	18	8			
					2623	19	6
„ Interest on Investments					265	2	8
Do. Deposit					21	11	6
„ Sales of Publications:—							
Transactions		76	2	3			
Journals		109	15	9			
Proceedings			17	0			
Library Catalogue		8	16	6			
					195	11	6
„ Donation in aid of Publication					20	0	0
„ Fellows' postal account, deposits					4	18	9
„ Miscellaneous Receipts					40	12	5
Income Tax not yet recovered £46 3 2.							

£3546 3 6

Library

	RECEIPTS.	£	s.	d.
To Interest on Investments		39	19	4
„ Carnegie United Kingdom Trust—1st Third of £2000 Grant		666	13	4
„ Transferred from General Account		633	6	8
Income Tax not yet recovered £6 6 4.				

£1339 19 4

YEAR ENDED APRIL 30TH, 1928.

Meeting, May 24th, 1928.)

*from May 1st, 1927, to April 30th, 1928.***Account.**

	PAYMENTS.	£	s.	d.	£	s.	d.
By House Expenditure :—							
Coal		54	12	6			
Electric Current	£23 7 6						
Electrical Repairs	16 3 0						
		39	10	6			
Gas		12	6	3			
Repairs, pictures	20 0 0						
Do. sundry	56 8 7						
		76	8	7			
Sundry payments		24	12	2			
Taxes and Insurance		33	2	4			
Tea at Meetings		35	10	10			
					276	3	2
„ Office Expenditure :—							
Miscellaneous Printing	119 13 2						
Postages and Sundry Expenses	124 16 7						
Stationery	54 3 11				298	13	8
„ Publications :—							
Printing	375 19 0						
Illustrations	154 3 2						
Distribution	27 5 6						
Library Catalogue	4 10 0						
					561	17	8
„ Salaries and Wages, etc.		1091	1	8			
„ Transferred to Library Account		633	6	8			
„ Payment of Contribution by Minchin Fellowship Fund			4	0 0			
„ Linnean Medal			15	0 0			
„ Fellows' postal account			6	8 6			
„ Balance at 30th April, 1928	604 3 3						
Do. Fellows' postal account deposits	53 8 6						
„ Cash in hand	2 0 5				659	12	2
					£3546	3	6

Account.

	PAYMENTS.	£	s.	d.
By Books		863	7	2
„ Periodicals		207	16	4
„ Binding		189	10	11
„ Balance of 30th April, 1928		79	4	11
		£1339	19	4

Separate Account.

	£	s.	d.		£	s.	d.
To Balance at 1st May, 1927 :—				By Westwood Fund :—			
Westwood Fund	£34	4	2	Grants for Illustrations in the Society's publications	6	9	6
Trail Award Fund	6	14	2				
Crisp Award Fund	42	12	1	„ Hooker Lecture Fund :—	20	0	0
Hooker Lecture Fund	70	1	6	Cost of Printing 1926 Lecture			
Goodenough Fund	15	17	4	„ Goodenough Fund :—	8	0	0
				Transferred to General Account			
„ Annual Dinner Fund Receipts	35	5	6	„ Crisp Award Fund :—	40	17	6
„ Anniversary Meeting Dinner Receipts ..	23	16	0	Medal and Award			
„ Linnean History Fund :—				„ Annual Dinner Fund :—			
Donation from Jackson Portrait Fund				Cost of Annual Dinner	35	5	6
Interest on Investments :—				Cost of Anniversary Meeting Dinner ..	23	16	0
Westwood Fund	£8	11	4				
Trail Award Fund	3	10	0	„ Balance at 30th April, 1928 :—			
Crisp Award Fund	7	10	0	Westwood Fund	£36	6	0
Hooker Lecture Fund	20	14	10	Trail Award Fund	10	4	2
Goodenough Fund	4	9	2	Crisp Award Fund	9	4	7
				Hooker Lecture Fund	70	16	4
				Goodenough Fund	12	6	6
Income Tax not yet recovered £1 12 0.				Linnean History Fund	21	9	6
					160	7	1
					<u>£294</u>	<u>15</u>	<u>7</u>

Auditors.
REGINALD CORY,
E. J. BUTLER,
R. PAULSON,
EDWARD T. BROWNE.

12

ADDITIONS AND DONATIONS

TO THE

LIBRARY.

1927-1928.

Note.—Separate copies of papers which are included in periodicals received by the Library are no longer catalogued. Names of donors are given in square brackets.

- Abderhalden, Emil.** Handbuch der biologischen Arbeitsmethoden. *Berlin*, 1925→ (Incomplete set.)
- Abel, O.** Grundzüge der Paläobiologie der Wirbeltiere. *Stuttgart*, 1912. [J. R. NORMAN.]
- Die Stämme der Wirbeltiere. *Leipzig*, 1919.
- Allen, Agnes.** *See* **Pearl, R.**
- André, Eugène.** A Naturalist in the Guianas, with a preface by J. SCOTT KELTIE. *London*, 1904. [T. A. SPRAGUE.]
- 'Astrolabe,'** Voyage de l'. *See* **France.**
- Australia, Commonwealth of (Fisheries).** Biological Results of the Fishing Experiments carried on by the F.I.S. 'Endeavour,' 1909-14. *Sydney*, 1926. [COMMONWEALTH OF AUSTRALIA.]
- Bacon, Agnes L.** *See* **Pearl, R.**
- Baker, E. C. Stuart.** The Fauna of British India: Birds, Vol. 4. Ed. 2. *London*, 1927. [THE SECRETARY OF STATE FOR INDIA.]
- Barla, J. B.** Les Champignons des Alpes-Maritimes. *Nice*, 1888.
- Barnes, B. F.** *See* **Gwynne-Vaughan, Dame Helen C. I.**
- Bayliss, W. M.** Principles of General Physiology. Ed. 4. *London*, 1927.
- Bentham, George.** Handbook of the British Flora. Ed. 7. Revised by A. B. RENDLE. *London*, 1924. [BENTHAM BEQUEST.]
- Berg, Leo S.** Nomogenesis, or Evolution determined by Law. Transl. by J. N. ROSTORTSOW. *London*, 1926. [BENTHAM BEQUEST.]
- Bergey, David H.** Manual of Determinative Bacteriology. *London*, 1926.
- Billerbeck, Julius.** Flora Classica. *Leipzig*, 1824.
- Bingham Oceanographic Collection.** Vol. 1, art. 1, Fishes, by C. M. BREDER, Junr. Vol. 3, art. 1, Ceratioidea, by ALBERT E. PARR. *New York*, 1927. [BINGHAM OCEANOGR. ASSOC.]
- Bois, D.** Les Plantes Alimentaires chez tous les Peuples et à travers les Ages. *Paris*, 1927.
- Borg, Folke.** Studies on Recent Cyclostomatous Bryozoa. *Uppsala*, 1926. [AUTHOR.]
- Borge, O.** Zygnemales. *See* **Pascher, A.**
- Boulger, G. S., & Perrin, I. S.** British Flowering Plants. 4 vols. *London*, 1914. [T. H. HISCOTT.]
- Bourdout, H., & Galzin, A.** Hyménomycètes de France. Pt. 1. *Paris*, 1928.
- Bower, F. O.** The Ferns (Filicales). Vol. 2, The Eusporangiate and other relatively primitive Ferns. (Cambr. Bot. Hdbks.) *Cambridge*, 1926. [AUTHOR.]
- Brightwell, C. L.** A Life of Linnæus. *London*, 1858. [R. MILLER CHRISTY.]
- Bronn, H. G.** Index Palæontologicus. 3 vols. *Stuttgart*, 1848.

- Brunnthaler, J.** Chlorophyceæ. *See* **Pascher, A.**
- Buddenbrock, W. von.** Grundriss der vergleichenden Physiologie: Pt. 1, Sinnesorgane u. Nervensystem; Pt. 2, Atmung, Effectoren. *Berlin*, 1925.
- Burfield, S. T.** Sagitta. *London*, 1927.
- Butler, Elmer G.** The relative rôle played by the embryonic veins in the development of the mammalian vena cava posterior.—*Repr. from Amer. Journ. Anat.*, vol. 39, no. 2, 1927. [AUTHOR.]
- Buxton, P. A., & Hopkins, G. H. E.** Researches in Polynesia and Melanesia . . . in 1924-25. Pts. 1-4 (relating principally to Medical Entomology). *London*, 1927. [AUTHOR.]
- Carnegie United Kingdom Trust.** Report on American Museum Work, by E. E. LOWE. A report on the public Museums of the British Isles, by Sir HENRY MIERS. *Edinburgh*, 1928. [CARNEGIE U.K. TRUST.]
- Carr, D. C.** The Life of Linnæus . . . to which is added a short account of the botanical systems of Linnæus and Jussieu . . . *Holt*, 1837. [R. MILLER CHRISTY.]
- Carr, J. W.** The Invertebrate Fauna of Nottinghamshire. *Nottingham*, 1926. [AUTHOR.]
- Castelnau, F. L. de L. de, Count.** Expédition dans les parties centrales de l'Amérique du Sud de Rio de Janeiro . . . exécutée pendant . . . 1843 à 1847. 14 vols. *Paris*, 1850-59.
- Ceylon. Department of Agriculture.** Guide to the Royal Botanic Gardens, Peradeniya. By T. H. PARSONS. *Colombo*, 1927.
- The Botanic Gardens, Henaratgoda. By K. J. A. SYLVA. *Colombo*, 1927.
- — The Botanic Gardens, Hakgala. By J. J. NOCK. *Colombo*, 1927. [THE DIRECTOR.]
- Chardon, C. E.** *See* **Seaver, F. J.**
- Child, C. M.** Physiological Foundations of Behaviour. *New York*, 1924.
- Chipp, T. F.** The Gold Coast Forest: a Study in Synecology.—*Oxford Forestry Memoirs*, no. 7, 1927. [AUTHOR.]
- Chun, Carl.** Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer 'Valdivia,' 1898-1899. . . Herausg. von Carl Chun. . . *Jena*, 1902.
- Chupp, Charles.** Manual of Vegetable-garden Diseases. *New York*, 1925.
- Clark, G. H., & Fletcher, J.** Farm Weeds of Canada. *Ottawa*, 1906.
- Coker, W. Chambers.** The Clavarias of the United States and Canada. *Chapel Hill, N.C., U.S.A.*, 1923.
- Collett, R.** Norges Paltedyr. *Kristiania*, 1911-12.
- Comber, H. F.** Andes Expeditions 1925-26 and 1926-27. Field Notes of Plants collected by H. F. Comber. *Edinburgh*, [1928]. [Hon. H. D. McLAREN.]
- Cooke, M. C.** A Manual of Structural Botany. New ed. *London*, [1870]. [H. FINDON.]
- Introduction to the Study of Fungi. *London*, 1895. [T. A. SPRAGUE.]
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- Country-Side Diary** for 1928. *Hitchin*, 1927. [R. MORSE.]
- Coventry, B. O.** Wild Flowers of Kashmir. Ser. 1. *London*, 1923.
- Ser. 2. *London*, 1927. [AUTHOR.]
- Cowdry, E. V.** General Cytology. 2nd ed. *Chicago*, 1925.
- Dakin, W. J.** *See* **Goldschmidt, R.**
- Dalman, J. W.** Arsberättelse om Nyare. Zoologiska Arbeten och Upp-täckter. *Stockholm*, 1827. [Prof. J. STANLEY GARDINER.]
- Dalziel, J. M., & Hutchinson, J.** Flora of West Tropical Africa. Vol. 1, pt. 1. *London*, 1927. [THE CROWN AGENTS FOR THE COLONIES.]
- Davenport, E.** Principles of Breeding: a Treatise on Thremmatology, with App. by H. L. RIETZ. *Boston*, [1907].
- Davison, W. C.** *See* **Waksman, S. A.**

- De Vries, Hugo.** Opera e periodicis collata. 7 vols. *Utrecht*, 1918-27.
- Deakin, R.** Flora of the Colosseum of Rome. *London*, 1873.
- Dean, Bashford.** A Bibliography of Fishes. Vol. 3. *New York*, 1923.
- Deutsche Südpolar-Expedition, 1901-1903 . . .** Herausg. von ERICH VON DRYGALSKI. Zoology, 11 Bd.; Botany, 1 Bd. *Berlin*, 1906-27.
- Deutschen Tiefsee Expedition.** See **Chun, C.**
- Devonshire Association for the Advancement of Science, &c.** Nineteenth Botany Report. Edited by G. T. Harris, Recorder.—*Repr. from Trans. Devonsh. Assoc.*, vol. 59. 1829. [G. T. HARRIS.]
- Dixon, H. N.** Muscineæ.—*W. Jongmans Fossilium Catalogus* 2: Plantæ. Pars 13. *Berlin*, 1927. [AUTHOR.]
- Docters van Leeuwen-Reijnvaan, J., & Docters van Leeuwen W. M.** The Zooecidia of the Netherlands East Indies. *Batavia*, 1926.
- Donisthorpe, H. St. J. K.** The Guests of British Ants, their habits and life-histories. *London*, 1927.
- Druce, G. C.** The Flora of Buckinghamshire. *Arbroath*, 1926.
- Drygalski, E. von.** See **Deutsche Südpolar-Expedition.**
- Ducomet, V.** Recherches sur le développement de quelques Champignons parasites à thalle subcuticulaire. *Rennes*, 1907.
- Dumont d'Urville, J. S. C.** See **France: 'Astrolabe' Expedition.**
- Dunn, H. L.** Variability in the growth of the fetal central nervous system as measured by biometric constants.—*Repr. Journ. Compar. Neurology*, vol. 42, no. 2. *Baltimore*, 1926. [Prof. LOWELL J. REED.]
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- Eastman, C. R.** See **Zittel, Karl A. von.**
- Ellis, David.** Iron Bacteria. *London*, 1919. [BENTHAM BEQUEST.]
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- Engler, A.** Deutsch Ost-Africa. See **Moebius, K.**
- Esdaile, Philippa C.** Economic Biology for Students of Social Science. Pt. 1. Harmful and Useful Animals. *London*, 1927.
- Essex Field Club.** Essex: An Outline Scientific Survey, incl. Geology, Botany, and Zoology. *Colchester*, 1926. [D. J. SCOURFIELD.]
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